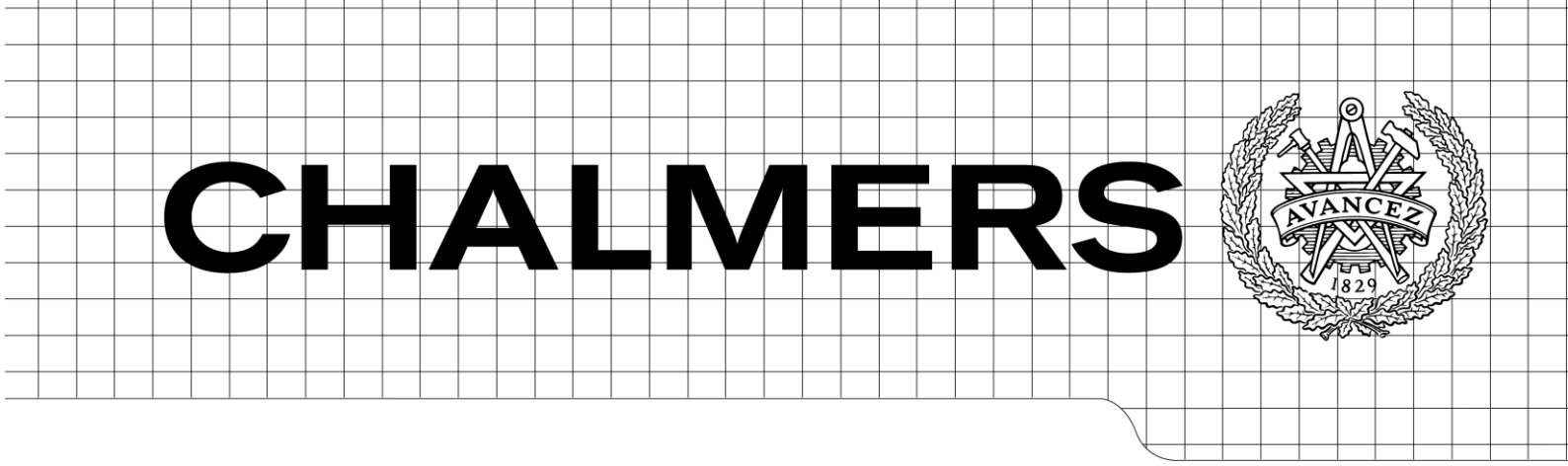

User Experience in Software Engineering

Master of Science thesis in Software Engineering

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Gothenburg, Sweden 2016

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User Experience in Software Engineering

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Abstract

User eXperience (UX) has gained interest in the software engineering research community in recent years. However, UX practitioners are still facing challenges to define “what is UX?”. Hence, many software companies are challenged to address the communication between users and software engineers. This thesis presents a systematic mapping study to get an overview of how UX has been researched in the field of software engineering and to identify the gaps in the existing literature about UX in software engineering. From the initial set of 29970 studies, 170 primary studies are selected and categorized. The main findings from this mapping study is that 1) the frequency of publications about UX has increased from 2007 and forward, 2) there is a lack of studies about tools and technology, 3) the domains in which we found most studies were about mobile and sales, 4) there is a lack of studies about tools in the business phase of the software development, and 5) most of the studies are about non-agile approaches.

Keywords- User experience; UX; Software; Systematic mapping study

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1

Introduction

Today, more and more IT companies are making user experience (UX) engineering an integral part of their development [42]. UX is a broad term that concerns meeting and producing the exact needs of the customer, including the simplicity and elegance of products [6]. Hassenzahl and Tractinsky [1] explains that the term ‘user experience’ is associated with a wide variety of meanings, ranging from traditional usability to beauty, hedonic, affective or experiential aspects of technology use. UX includes all emotions, beliefs, preferences, perceptions, physical and psychological responses, behaviors and achievements that occur before, during and after the use of a product [20]. High-quality UX is achieved in a company by merging the services of multiple disciplines, including engineering, marketing, graphical and industrial design, and interface design [6]. Despite the growing interest in UX, it has been hard to gain a common agreement on the nature and scope of UX [43]. The landscape of UX research is fragmented and complicated by diverse theoretical models with different foci such as pragmatism, emotion, affect, experience, value, pleasure, beauty, hedonic quality, etc. [43]. According to Law et al. [43], UX is seen as something desirable, though what exactly ‘something’ means remains open and debatable.

UX points to a more global projective goal: not just attain effectiveness, efficiency, and satisfaction, but to enhance the entire experience of the user, from the expectation, through interaction and finally the reflection about the experience [20]. On the other hand, business contexts represent a big challenge for software development, specifically in terms of finding a balance between business goals and user goals [8]. Communication between UX designers and software developers is very important because each group will have different priorities, goals, and processes [4]. According to Anitha and Prabhu [46], the pressure of competitors has influenced most organizations to pay serious attention to the users that they are creating products for. In the past, usability engineering has tried to improve the usability of software that users are required to use, making them more effective, efficient and satisfied [44,45]. However, merely providing usable software is not enough anymore to motivate users, and hence support the achievement of business goals [8]. To achieve the user goals comes from

generating a positive UX with the software that people have to use at the workplace [8]. Moreover, good UX is the consequence of the achievement of user goals and the fulfillment of human needs [8].

More product and service providers are recognizing that UX qualities are success factors for selling their products and services [47]. In general, UX literature emphasizes that assuring efficiency and effectiveness, i.e., usability, does not guarantee the overall end user satisfaction or pleasure [1]. According to Law et al. [10] the software engineering community has recognized that usability does not only affect the design of user interfaces but also the software system development. One of the main challenges in designing for UX is its highly subjective nature [14]. Designing UX for interactive systems is a complex venture, and one of the main challenges is to integrate UX factors into the design of a new system, which match with the user's expectations and needs [53]. According to Hassenzahl and Tractinsky [1] UX became a buzzword in the field of Human Computer Interaction (HCI) and interaction design. A further complication is that HCI and software engineering disciplines speak different languages and have different orientations to design [69]. According to Ogunyemi et al. [69] the challenge of transferring HCI values and practices to software engineering processes has been attributed to the lack of establishing standards of practice between the two fields [69]. For example, the non-involvement of the actual users in software products design process by software developers, is a demonstration of the transfer problems between the HCI and software engineering[69].

In this thesis, the author conducted a systematic mapping study in order to get an overview of how UX has been researched in the field of software engineering and to identify the gaps in the existing literature about UX in software engineering. Systematic mapping studies in software engineering have been recommended mostly for research areas where there is a lack of relevant, high-quality primary studies [19]. A systematic mapping study provides an objective procedure for identifying the nature and extent of the research that is available to answer a particular research question [39, 50]. Also, this method helps to identify any gaps in the current investigation in order to suggest areas for further research [39, 50].

The remainder of this thesis is structured as follows: in section 2, the author presents the background and related work. In section 3, the author describes the applied research approach Systematic Mapping Study. Section 4 presents the results of the Systematic Mapping Study followed by a discussion in section 5. In section 6, the thesis ends with a conclusion and a future work.

2

Background and Related Work

The purpose of this section is to provide the background of this study followed by a review of related literature.

2.1 Background

According to Hassenzahl and Tractinsky [1], UX is a consequence of a user's internal state, the characteristics of the designed system and the context within which the interaction occurs. Good UX is influenced specifically by five needs: autonomy, competence, stimulation (self-oriented), relatedness, and popularity [7]. According to Law et al. [10] the concept of UX is commonly understood as subjective, context-dependent and dynamic. According to ISO 9241-210 [44], UX is "*a person's perceptions and responses that result from the use or anticipated use of a product, system or service*". A prerequisite of designing for a delighting UX in an industrial setting is to understand both the requirements tied to the pragmatic level of functionality and interaction and the requirements pertaining to the hedonic level of personal human needs, which motivate product use [11]. UX is a momentary, primarily evaluative feeling (good-bad) while interacting with a product or service [7]. Schulze and Krömker [9] defined UX as *"the degree of positive or negative emotions that can be experienced by a specific user in a specific context during and after product use and that motivates for further usage"*. The concept of UX was rapidly adopted by the communities of Industrial Design, Interaction Design, HCI, and Ergonomics/Human Factors which are all concerned with the quality of products and the challenge of creating positive UX with them [49]. However, the definition about UX varies on various papers [4, 6, 49]. According to Law et al. [43], UX has been widely disseminated and speedily accepted in the HCI community, however, without it being clearly defined or well understood.

According to Jurca [4], usability is an important factor to consider for any product. Lack of usability on a company's internal applications will reduce an employee's work

efficiency [4]. Bevan [72] claims that the ISO definition suggests that measures of UX are similar to measures of satisfaction in usability. A distinction can be made between usability methods that have the objective of improving human performance, and UX methods that have the objective of improving user satisfaction with achieving both pragmatic and hedonic goals [72]. According to Bevan [72], the notes that accompany the definition of UX in ISO FDIS 9241-210 show some ambivalence as to whether usability is part of UX, stating that *"User experience includes all the users' emotions, beliefs, preferences, perceptions, physical and psychological responses, behaviours and accomplishments that occur before, during and after use"* [74]. If UX includes all behaviour, it presumably includes the user's effectiveness and efficiency [72]. Bevan [73] discusses that UX is an elaboration of the satisfaction component of usability and in other places Roto et al. [75] claims that UX is distinct from usability, which has a historical emphasis on user performance.

"Good UX is the consequence of fulfilling the human needs for autonomy, competency, stimulation (self-oriented), relatedness, and popularity (others-oriented) through interacting with the product or service (i.e., hedonic quality). Pragmatic quality facilitates the potential fulfilment of be-goals" [7]. UX is driven by commercial vendors who are sensitive to the changes in business climate, by designers who appreciate new design opportunities, and by a scientific community that shows renewed interest in the affective system and its interplay with cognition [1]. According to Nielsen & Norman [6], UX encompasses all aspects of the end user's interaction with the company, its services, and its products. The UX considers the wider relationship between the product and the user in order to investigate the individual's personal experience of using it [6]. While usability focuses on how the system is easy to learn and efficient to use, UX covers a much broader concept [6]. Some of the challenges could be due to low level of knowledge and awareness about UX as well as limited theory and practice available for software engineer practitioners on how to address UX in software development [16, 17]. Agile software engineering today has become a mainstream development methodology [12], which has led to a new concept that is a combination of agile and User Centered Design called agile-UX [4]. However, agile itself does not necessarily secure that the final product has a great UX. Therefore, there have been many efforts to integrate UX into the agile for better and more effective final results.

According to Hassenzahl and Tractinsky [1] *"User eXperience (UX) is a strange phenomenon: readily adopted by the human – computer interaction (HCI) community – practitioners and researchers alike – and at the same time repeatedly critiqued for being vague, elusive, ephemeral"*. Hassenzahl and Tractinsky [1] argue that UX is mainly focused on the programmatic aspect and aim to convince the HCI community to take issues beyond the task-related more seriously. Later literature about UX include more conceptual papers that have tried to establish a common ground, a shared view of what constitutes a 'good' user experience [1]. Hassenzahl and Tractinsky [1] address the lack of empirical research in UX by collecting a series of original, high-quality empirical papers on various aspects that go beyond the purely cognitive and task-oriented aspects. UX has gained momentum in recent years,

mostly as a countermovement to the dominant, task- and work-related 'usability' paradigm [1]. The developers are focused on the quantities and contents of the applications, but they are underestimating the importance of user experience and capabilities [25].

As mentioned earlier, UX plays a significant role in various fields such as Industrial design, Product design, the Web-based development, Graphical User Interface design. Some of these studies have attempted to see how UX could be integrated into the mainstream conventional development processes such as agile [4]. In the last decade, software development has been characterized by two major approaches: agile software development, which aims to achieve increased velocity and flexibility during the development process, and user-centered design, which places the goals and needs of the system's end-users at the center of software development [26]. According to Ferreira [27], with the transition towards agility and agile software development, there is an increasing need for understanding how agile developers and UX designers work together in practice. For practitioners, the benefits of agile development combined with UX design include an improved product [28,29], better quality of the user experience [30], increased team confidence [31], team morale [32,33], as well as devotion and satisfaction [34].

Both agile development and UX design aim to build quality software, but despite their common concern, each of them approaches the development from a different perspective [27]. While agile methods mainly describe activities addressing code creation [35], UX design methods describe activities for designing the product's interaction with a user [36]. Agile software engineering and User-centered design are two important processes in developing applications with good user experiences, but these two processes are different, and the integration of these two processes remains difficult [4]. According to Schwartz [37], Agile-User Experience Design, (Agile-UX) is a project management principle for software development that is based on agile values and principles, and on the User-Centered Design (UCD) method. However, very few evaluation and validation papers are published to address the integration of Agile and UX [4].

The combination of UX design with agile development helps practitioners maintain focus on important aspects of software development [27]. Kuusinen and Väänänen-Vainio-Mattila [38] describe the state of UX work in development and sales processes in a large, globally-operating IT service company. According to them [38], UX design has traditionally been conducted prior to starting the development. Therefore, it is still often run outside agile development, as a separate stream of a work [38]. Moreover, as the costs of UX work were separated from other project costs, it was easy for a customer to exclude UX work to cut costs [38]. Many other factors could be listed that can impact the UX of a software product. According to Nass & Adam [8] one of the largest challenges for software development is to find a balance between business goals and user goals. While the main goal of an application is to deliver needed functionalities for the worker to be able to do their jobs, it would be beneficial for their motivation, their health and consequently their performance if the software were not only functional but that doing the job would be a pleasure for them [15].

2.2 Related work

The discipline of HCI uses knowledge derived from computer science, psychology, and related disciplines to design interactive computing systems for human use [69]. The challenge of transferring HCI values and practices to software engineering processes has been attributed to the lack of established standards of practice between the two fields [69]. This makes adherence to standard practice difficult for new members to each community. According to Ogunyemi et al. [69] both the HCI and software engineering disciplines speak different languages and have different orientations to design. According to Brown et al. [88] there is no clear definition of the relationship between values and practices in HCI and software engineering.

Usability is one of the important quality attributes in software and it is necessary to include in the development process for obtaining good acceptance rates and, consequently, improving the quality of the applications [39]. A study about usability evaluation methods for the web shows that usability is one of the most important quality factors for Web applications [39]. A study about approaches to support the evaluation of usability in mobile apps in the last 10 years, shows that many publications justifies the use of usability [90]. According to Saleh and Ismail [89], the prominent framework of usability evaluation is not efficient to pick up the drawbacks of a user interacting with mobile applications on a mobile platform. The extended use of the mobile application is growing rapidly, with increasing application development in usability occupying the crucial phase of mobile application development and mobile computing industry [89].

The mapping studies published by Reis et al. [90] and Fernandez et al. [39] shows that the majority of the studies about tools focused on the testing phase in software development processes. Also, the majority of the proposed technologies have been for the testing phase rather than the development and design phase [63]. According to Silva da Silva et al. [63], a new technology to support correcting usability problems in the early stages is less expensive and avoids rework effort from practitioners. According to Ogunyemi et al. [69], some of the studies published about tools still require empirical validations and use in production environments.

Some of the studies discuss the challenges to integrating agile and software engineering. For example, a study about the adoption of agile methods in an outsourced project shows the lack of including discussion about agile software development methodologies [91]. Also, the study published about Agile and UCD [4], shows that one of the problems of integrating Agile and UX design is the synchronization of their activities and practices [4]. Jurca [4], found that only a few number of evaluation and validation studies are published focusing on Agile and UX, and their mapping study mainly focused on agile methodologies. In this thesis we are broadening the study to include a more holistic view of the state-of-art of UX research in software engineering. The result of this thesis will provide an overview and show if there are

gaps in the existing literature related to UX studies in software engineering that can guide future research in the field.

3

Research Approach

This section describes the method of this research. First, the purpose of this study is presented, followed by a description of the research methodology, and finally, the section ends with validity threats.

3.1 Research Purpose

The purpose of the study is to provide an overview of the state-of-art and to identify any areas about UX in software engineering field that need further research.

3.2 Research Methodology

The Systematic mapping study was chosen as the research methodology in this thesis based on its recommendation in software engineering for research areas where there is a lack of relevant, high-quality primary studies [19, 2]. According to Petersen et al. [2], the systematic reviews focus about identifying best practices based on empirical evidence, however, it is not a goal for systematic maps, and cannot be since they do not study articles in enough detail. Instead, the main focus here is on classification, conducting thematic analysis, and identifying publication fora [2]. The systematic mapping study, and in particular a thematic analysis is an interesting analysis method as it helps to see which categories are well covered in terms of number of publications [2].

3.2.1 Systematic Mapping Study

Systematic mapping is the concept of using evidence-based paradigm and had significant success in research and practices in the medical field [2]. Systematic mapping study emerges

lately in software engineering areas. Petersen et al. [2] suggested that systematic mapping study provides a structure of the type of research reports and results that have been published by categorizing them, and it gives a visual summary, the map, and the results of the outcome about the research topics. To answer the research questions of this study (Section 3.2.1.1) the author chose to perform a systematic mapping study, which is capable of dealing with wide and poorly defined areas about UX in software engineering. The implementation of the systematic mapping process in this thesis is followed as proposed by Petersen et al. [2]. Figure 3.1 illustrates the systematic mapping process with the process steps; definition of research questions, conduct the search, screening of relevant papers, keywording using abstracts, and data extraction and mapping. The individual processes are explained in Sections 3.2.1.1 to 3.2.1.5., and the outcome of the process is a systematic map.

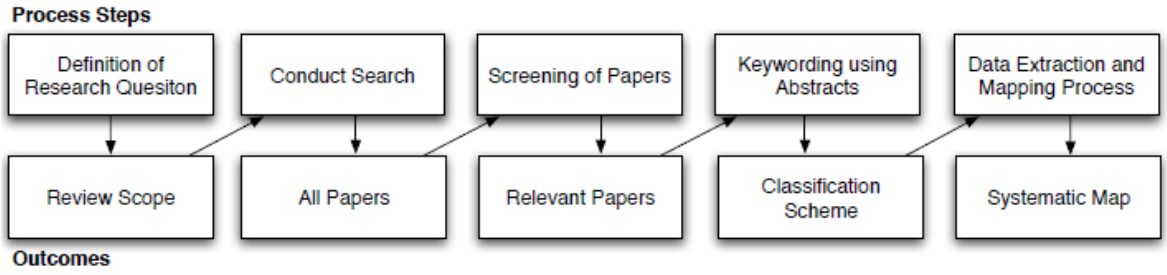

Figure 3.1 Systematic Mapping Process (Petersen et al. [2], p2)

3.2.1.1 Definition of research questions

In this thesis, the first objective is to provide an overview of the research area, identify the quantity, type of research, results available in the focus area as suggested by Petersen et al. [2]. According to Petersen et al. [2] a secondary goal can be to identify the forums in which research in the area has been published. In line with this, the secondary goal is to determine the forums in which research in the area is published. The research questions, in this thesis that drives the mapping study, are:

The focus is on UX in software engineering regarding:

RQ1: What is the frequency of publications over time?

RQ2: What types of studies are published?

RQ3: In what domains have studies been conducted?

RQ4: What are the UX tools used in different software development phases?

RQ5: How are UX studies distributed between agile and non agile methodologies?

In RQ1, the aim is to identify the frequency of publication about UX in software engineering over time. In RQ2, the aim is to classify the papers into different categories such as contribution type, research type and focus facet about UX in software engineering. In RQ3,

the goal is to find what domains these studies have been conducted in. In RQ4, the aim is to analyze what UX tools are used in software development phases such as business planning, requirement, development and testing phases. In RQ5, the aim is to identify how these UX studies are distributed between agile and non-agile methodologies.

3.2.1.2 Conduct search

The author identified the primary studies by exercising a search string on the scientific databases Engineering Village, IEEE Xplore, Scopus, ACM Digital Library, and Google Scholar. The author identified the 58 keywords (see Appendix A.1) related to UX in software engineering. The initial set of keywords considered for the analysis is shown in Appendix A.1. After the initial keywords, author combined the various possible combinations of the keywords related to UX and Software, also included the synonymous of the identified keyword combinations. The result of the number of papers from the first keywords is shown in Appendix A.2. The final set of keywords are **("user experience" OR "user-experience" OR UX OR usability) AND software**. By using the final set of keywords the author selected randomly 50 papers from Engineering Village database to verify the Fleiss' Kappa value by categories as 'Include' or 'Exclude'. Initially, this mapping study involved two students conducting the search of publications until March 2015. However, the Systematic Mapping study was continued by one of the students and extended to include publications until December 2015.

During the time when two students were working in the study, the statistic kappa was introduced to measure nominal scale agreement between a fixed pair of raters during the search [21]. According to Fleiss, [21] Kappa is useful when all disagreements may be considered equally serious, and weighted kappa is useful when the relative seriousness of the different kinds of disagreement can be specified. Also, Fleiss added that the generalization of unweighted kappa to the measurement of agreement among any constant number of raters where there is no connection between the raters judging the various subjects [21]. Therefore, authors consider Fleiss' Kappa value helps to identify if two authors have any disagreement with the research study. For the pilot work, the two students individually assessed 50 randomly selected publications and the result of the first 50 papers showed a low agreement (0.406) of the review. According to Landis and Koch [22], the Fleiss' Kappa values in the range of 0.21 -0.40 are considered as Fair (details of the Fleiss' Kappa values [21], proposed by Landis and Koch [22] as shows in table 3.1). Then, the authors conducted a post-mortem analysis to understand the causes of the low agreement with Kappa value. As a primary reason, the same paper was excluded by one but included by the other that caused the poor results in the Fleiss' Kappa value.

Table 3.1: Agreement measures for categorical data [22]

Kappa Statistic	Strength of Agreement
< 0.00	Poor
0.00-0.20	Slight
0.21-0.40	Fair
0.41-0.60	Moderate
0.61-0.80	Substantial
0.81-1.00	Almost Perfect

After discussions, an "Unsure" category was introduced to classify publications that should be assessed until a consensus was reached. With this help, the Fleiss' Kappa increased to a moderate agreement (0.59). The publications in the category "Unsure" were discussed and in the end included. The next set of 50 papers were again reviewed individually by the two students and the results of the Fleiss' Kappa value agreement improved to 0.76 as shown in the Table 3.2. Authors used the IBM SPSS Statistics tool to perform the Kappa values [A] and the complete detail of the Kappa values from IBM SPSS Statistics tools is shown in the Appendix A.3.

Table 3.2 Symmetric Measures Kappa value

Symmetric Measures					
		Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Measure of Agreement	Kappa	.766	.090	6.648	.000
N of Valid Cases		53			

[A] IBM SPSS Statistics is an integrated family of products that addresses the entire analytical process, from planning to data collection to analysis, reporting and deployment. Authors used this tool to calculate the Kappa value.

After the pilot search and review, the search using the final set of keywords (see section 3.2.1.2) were conducted in all the selected databases as shown in Table 3.3 along with the number of publications retrieved from each database. The extended search by the single author considered all the databases to identify relevant publications up to December 2015.

Table 3.3 Selected databases and retrieved papers

ID	Database	Papers
A	Inspec/Compendex (www.engineeringvillage2.org)	9077
B	IEEE Xplore (www.ieeexplore.ieee.org)	4514
C	Scopus (www.scopus.com)	9659
D	ACM Digital Library (dl.acm.org/advsearch.cfm)	2890
E	Google Scholar (scholar.google.com)	3830
	Total	**29970**

3.2.1.3 Screening of relevant papers

The next step was to identify what publications to include versus exclude in the study. The main criterion that guided the inclusion of a publication was that it presented a contribution to the body of knowledge that related to UX in software engineering. The main criteria that guided the exclusion of a publication was that it was:

- Duplicate,
- Not peer-reviewed (books, presentations, blog posts, gray literature, etc.),
- Not written in English.

For the screening of the publications, the author followed the workflow in Figure 3.2. The author used the reference management tool (called Mendeley) to merge all the five results listed from the search in the scientific databases. The total papers retrieved from all the databases are 29970 papers as shown in Figure 3.2, including duplicates. The author removed the duplicates in two steps: first, using the reference management tool (Mendeley) to detect the duplicates based on publication author, publication year and publication title automatically, and second, manually identifying and deleting all the instances that were not detected by the Mendeley tool. The duplicates found in all the database were 8975 publications as shows in Figure 3.2.

After the removal of duplicates, the author analyzed the remaining titles and the result shows 20995 papers are considered for the primary study based on title. 22 publications were excluded that are not published in English. 16320 publications were excluded 16320 that were not related to UX in Software engineering, which resulted in 4655 paper. Then, the author analyzed the abstract of each paper (4655), to check whether it matched the research inclusion

criterion. 388 publications were excluded that were not accessible, and 3559 publications were not related to the research study. The outcome of the analysis of abstracts is 708 papers related to the research study and continued for the Full-text reading process. After reading the full-text, the author identified 476 publications not related to UX in software engineering, and 71 publications were not accessible. The results from the primary study selection is the total of 170 publications related to the research questions as shown in Figure 3.2.

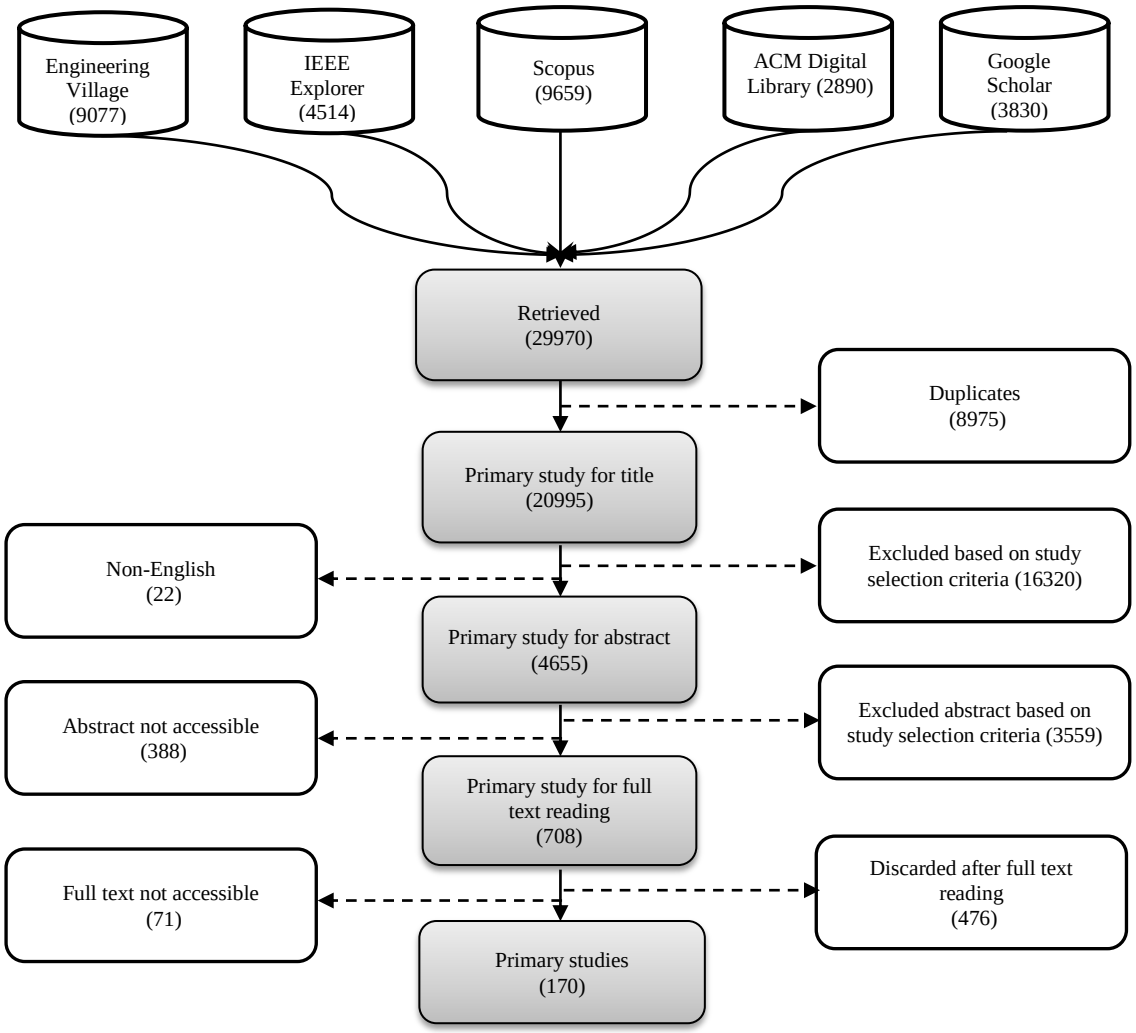

Figure 3.2 Primary Studies Selection (adapted from Unterkalmsteiner et al. [93], p5)

3.2.1.4 Keywording using Abstracts

The goal of keywording using abstracts is to create a classification schema efficiently, ensuring that all relevant papers are taken into account [2, 18]. The author followed the process illustrated in Figure 3.3 as suggested by Petersen et al. [2] and did the keywording in two steps. The first step referred to reading the abstracts of the 170 primary studies, assigning them a set of keywords to identify the main contribution area of the paper. While doing so, the

author also identifies the context of the research. Then the set of keywords from different papers were combined to develop a high-level set of categories, leading to a rough understanding of the research areas represented by the primary studies. When the abstracts were of too poor quality for proper understanding to allow for meaningful keywords, the author chose to study the full text of the paper. By progressively fitting the papers into categories, the schema underwent a refinement process, being continuously updated to account for new data [2, 18]. When performing data extraction and mapping (Section 3.2.1.5), the author annotated the classification with evidence from the respective paper, further refining the schema and sorting as suggested by Petersen et al. [2]. The details of the classification schema are discussed in Section 3.1.1.5 and also used in the analysis of the results in Sections 4 and 5.

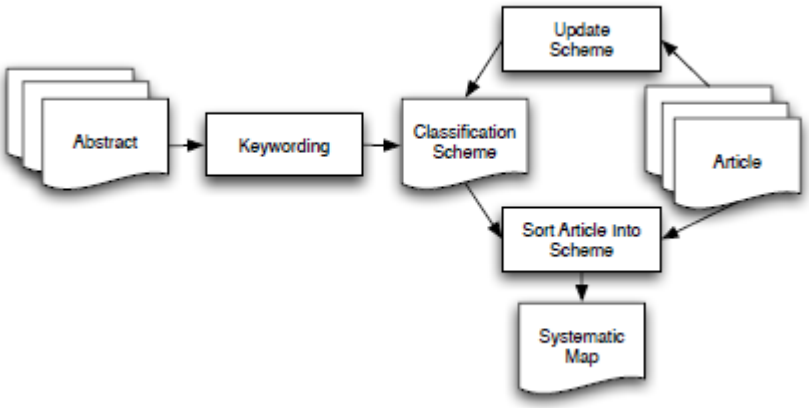

Figure 3.3 Building the Classification Scheme (Petersen et al. [2], p4)

A classification schema can be adapted from other existing taxonomies or emerged from the keywording process as suggested by Petersen et al. [2]. The classification schema consists of the following three facets:

- **Research type**: to represent the type of papers used in the research study [2].
- **Contribution type**: to map the different types of the study outcomes [18].
- **Focus**: to define the main focus of the research.

The research type facet in Table 3.4 is used to distinguish between different types of studies, abstracting from the particular underlying research methodology [18]. The author followed the research types as suggested by Wieringa et al. [23] and Petersen et al. [2].

Table 3.4 Research type facet [2, 23]

Category	Description
Evaluation research	Techniques are implemented in practice and an evaluation of it is conducted. That means, it is shown how the research is implemented (solution implementation) and what are the consequences of the implementation in terms of benefits and drawbacks (implementation evaluation). This also includes problems identified in industry.
Solution proposal	A solution for a problem is proposed. The solution can be either novel or a significant extension of an existing methodology. The potential benefits and the applicability of the solution is shown by a small example or a good line of argumentation.
Philosophical papers	These papers sketch a new way of looking at existing things by structuring the field in form of a taxonomy or conceptual framework.
Opinion papers	These papers express the personal opinion of somebody whether a certain technique is good or bad, or how things should have been done. They do not rely on related work and research methodology.
Experience papers	Experience papers explain what and how something has been done in practice. It has to be the personal experience of the author.

The research type facet in Table 3.4 is used to distinguish between different types of studies, abstracting from the particular underlying research methodology [18]. The author followed the research types as suggested by Wieringa et al. [23] and Petersen et al. [2].

The contribution facet in Table 3.5 describes the kind of contribution a study provides. The author followed the contribution types as suggested by Shaw [24] and Paternoster et al. [18], but adapted the category Framework/methods and Tool to this study. According to Paternoster et al. [18], contribution types can be divided into weak (which includes advises and implications, lessons learned, tools and guidelines papers) and strong (which includes theory, framework/method, and model).

Table 3.5 Contribution facet [adapted from 18, 24]

Category	Description
Model	Representation of an observed reality by concepts or related concepts after a conceptualization process.
Theory	Construct of cause-effect relationships of determined results.

Framework/methods	Models for constructing/managing user experience in software engineering.
Guidelines	List of advices, synthesis of the obtained research results.
Lesson learned	Set of outcomes, directly analyzed from the obtained research results.
Advice/implications	Discursive and generic recommendation, deemed from personal opinions
Tool	Tools/Instruments/artefacts/methods used in different software development phases for business planning, requirement, development and testing about UX

The categories in the focus facet shown in Table 3.6 is adapted from Paternoster et al. [18]. The author distinguished the studies focused on higher-level process management (e.g. Extreme Programming, Scrum, Release Fast, Lean, Agile, Process Assessment), studies focused on specific tools and technologies (e.g. Use of whiteboards, Use of wiki, Use simple tools), and studies focused on managerial/organizational aspects in Software engineering (e.g. Project Management, Release Planning, Collective code ownership, Working experience).

Table 3.6 Focus facet (adapted from Paternoster et al. [18])

Category	Description
Process management	Engineering methods and techniques used to manage UX in software engineering.
Tools and technology	Instruments used to create and maintain UX in different software development phases
Managerial/ Organizational	Aspects that are related to UX in software engineering, by means of resource management and organizational structure.

The classification schema in Table 3.4, 3.5 and 3.6 forms the basis for the systematic maps presented and discussed in the results (Section 4).

3.2.1.5 Data extraction and mapping (Systematic Map)

Data extraction and mapping is the final phase of this mapping study. After defining the classification schema, based on the keywording process, the author proceeded to systematically extract data from the primary studies. According to Petersen et al. [2] when having the classification scheme in place, the relevant articles are sorted into the scheme, i.e., the actual data extraction takes place. In order to extract data from the primary studies systematically, author developed a protocol. For each paper, the author filled a spreadsheet, sorting it into the classification schema and extracted the following data:

- Article Title
- Author
- Year of Publication
- Publication Fora
- Publication Type
- Research Methodology
- Domain
- Research Type
- Contribution
- Focus
- UX Strategy

The author prepared tables for the extracted data and connected each data with respective research question as shown in Table 3.7.

Table 3.7 Extracted Properties

Data to Extract	Research Question
Research Methodology	Overview
Publication year	RQ1
Publication Fora	RQ1
Publication Type	RQ1
Domain	RQ3
Research Type	RQ2,RQ3,RQ4,RQ5
Contribution	RQ2,RQ3,RQ4,RQ5
Focus	RQ2
UX strategy	Overview

Along with entering a publication into the scheme, the author also provided a short rationale for why the paper should be in a particular category as suggested by Petersen et al. [2].

3.3 Validity Threats

The validity of a study denotes the trustworthiness of the results, and to what extent the results are true and not biased by the researchers subjective point of view [76]. It is, of course, too late to consider the validity during the analysis. The author identified potential threats to the validity of the systematic mapping and its results, together with selected mitigation strategies. Wohlin et al. [76] suggested four main types of validity threats: conclusion, internal, construct, and external for qualitative research in software engineering.

3.3.1 Conclusion Validity

Threats to the conclusion validity (also known as reliability validity) are concerned with issues that affect the ability to draw the correct conclusion [76]. Keyword identification is considered as conclusion validity in the author's mapping study.

Keyword identification

In systematic mapping study choosing keywording is important to efficiently create a classification schema, ensuring that all relevant papers are taken into account [2, 18]. It is possible that wrong keywords will rout to incorrect mapping, and it is possible that researchers may identify different keywords than the author have in this mapping study. To mitigate this threat, the author have documented the details of the keywords used in the mapping study (refer Appendix A.1 and A.2) together with an explanation of each step of the classification scheme.

3.3.2 Internal Validity

Internal validity is of concern when causal relations are examined. When the researcher is investigating whether one factor affects an investigated factor, there is a risk that the investigated factor is also affected by a third factor. If the researcher is not aware of the third factor and/or does not know to what extent it affects the investigated factor, there is a threat to internal validity [76]. According to Kitchenham [71], internal validity is the extent to which the design and conduct of the study are likely to prevent systematic error and also internal validity is a prerequisite for external validity. Therefore, identifying and addressing the internal validity could improve the applicability (generalisability) of the findings. In systematic mapping study, the author encountered the risk of bias for selection and attrition of the articles.

Attrition Bias

Attrition bias (also called exclusion bias) is the systematic differences between comparison of groups in terms of withdrawals or exclusions of participants from the study sample [71]. While conducting the mapping studies, there is a risk for researcher bias in the inclusion and exclusion of articles [70]. To mitigate the risk, the author created inclusion and exclusion criteria for the selection of inclusion versus exclusion of publications.

Selection Bias

Selection bias may occur during identification of the study population [70], and when different authors analyze a particular article [71]. When several authors are analyzing articles it might lead to different opinions and decisions. To mitigate this threat, the author conducted a pilot study using Fleiss' Kappa value for randomly selected 50 papers to identify if the initial two authors had any disagreement with the research study. A common agreement was observed, which suggests that the authors had similar opinions. Based on this result, the single author carried on with the study.

3.3.3 Construct validity

Construct validity concerns generalizing the result of the experiment to the concept or theory behind the experiment [76]. A major threat to the construct validity is that the chosen perspectives or the reading techniques for the perspectives may not be representative or good for scenario-based reading, and it limits the scope of the conclusions made to these particular perspectives and techniques [76]. In this systematic mapping study, the author considered article coverage as construct validity.

Article Coverage

In systematic mapping study, there might be a threat of missing out on a few articles that are related to this study. To avoid this risk, the author have done both manual and automated searches of publications in databases, journals and conference papers published about UX in software engineering.

3.3.4 External validity

External validity concerns to what extent it is possible to generalize the findings, and to what extent the findings are of interest to other people outside the investigated case. During the analysis of external validity, the researcher tries to analyze to what extent the findings are of relevance for other cases [76]. Since this mapping study do not rely on a specific case but aggregate an overview of research on UX in software engineering, the external validity threats are not applicable.

4

Results

This section presents the results of the Systematic Mapping Study about UX in software engineering. The structure is based on the research questions presented earlier for the identified 170 primary studies (see Figure 3.2).

4.1 Frequency of publications

Figure 4.1 shows the frequency of publications distributed over the years from 1995 to 2015. The results show that only 15% of the studies are published before 2007, and that 85% of the studies about UX in software engineering are published from 2007 and after. The result shows a variation of 7% to 12% the years 2007-2015, with a peak of 15% in year 2014. The result clearly indicates an increased attention to research about UX in software engineering over the period.

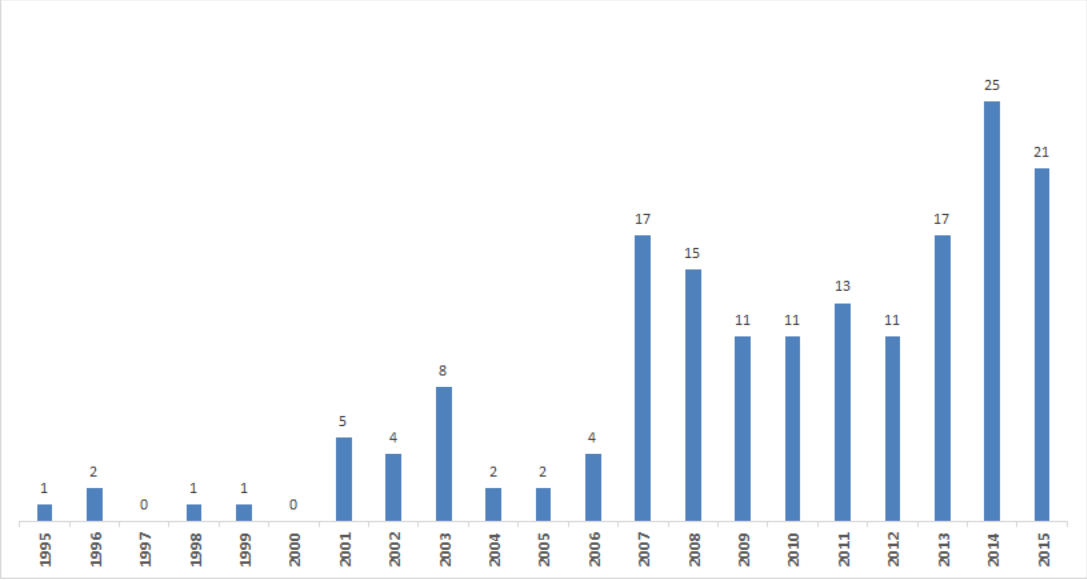

Figure 4.1 Publication distribution-year

Figure 4.2 presents the characterization of primary studies and shows that 41% of the papers referred to the concept *user experience* and the other 59% of the papers discuss the importance of UX using related concepts.

About 21% of the studies discuss the topic from the concept of *Usability*. Usability is one important part of UX. According to Hartson and Playa [59] usability, usefulness, and emotional impact are three components that characterize UX. Another concept used to discuss the topic is *User-Centered Design* 19%. According to Lester [65], user-centered design focuses on the inclusion of the user throughout the development process and the creation of a user experience that is pleasing to the user. The author found a variety of similar concepts related to user-centered design such as *Human-Centered Design* 3%, *Usage-Centered Design* 2%, *User Emotions* 1%, *User Involvement* 1%, *User Interface* 1%, and *User Perspective* 1%. A third concept used to discuss the topic is *Human Computer Interaction* (HCI) 10%. HCI is another important field, which is the idea of the technological system interacting with users in a seamless manner to meet users needs [65]. In order to create an effective UX in HCI, Lester [65] discusses that a designer of an interactive computer system must understand the user for which the system is being created, the technological system that is being developed, and the interaction that will take place between the user and the computer system.

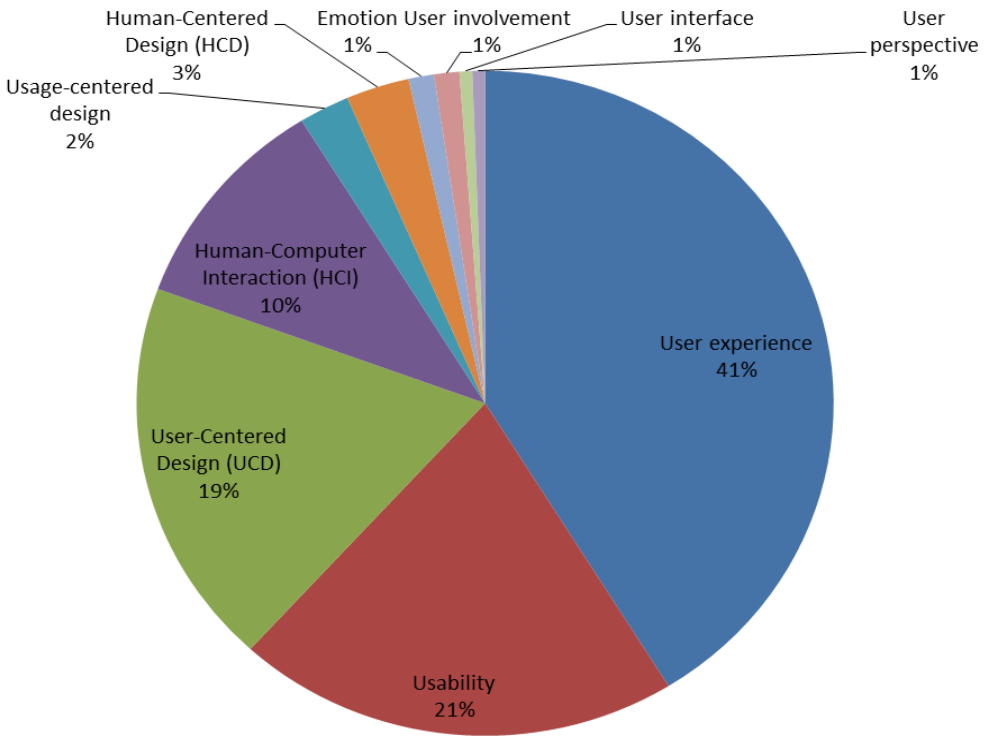

Figure 4.2 Characterization of Primary Studies

The details of the studies by publication fora are summarized in table 4.1 categorized into journal article, conference article, and book chapter. The result shows that the majority of the studies are published as conference articles, in total 125. In the category of journal articles, there are 37, and in the category of book chapters, there are 8 publications.

Table 4.1 Distribution of publication fora

Publication For a	Type	#
Conference on Information Systems and Technologies (CISTI)	Conference	3
International Conference on Advanced Information Systems (CAiSE)	Conference	1
Asia-Pacific Software Engineering Conference (APSEC)	Conference	1
Christian Community Development (CCD)	Conference	1
The Charities and Associations Event (CHASE)	Conference	2
Extended Abstracts on Human Factors in Computing Systems (CHI EA)	Conference	7
Computer-Human Interaction in Play (CHI PLAY)	Conference	1
International Conference on Collaboration Technologies and Systems (CTS)	Conference	1
DESIGN conference	Conference	1
International Conference on Design, User Experience and Usability (DUXU)	Conference	3
International Conference on Engineering and product Design Education(E&PDE)	Conference	1
Working Conference on Engineering for Human-Computer Interaction (EHCI)	Conference	1
EUROMICRO	Conference	1
Human Centered Design (HCD)	Conference	2
AGILE	Conference	12
Human-Computer Interaction International Conference (HCI)	Conference	15
Valid Useful User Experience Measurement (VUUM)	Conference	1
Software Engineering: Education and Practice	Conference	1
Workshop on Advanced Research and Technology in Industry Applications (WARTIA)	Conference	1
Western Conference on Science Education (WCSE)	Conference	1
International Symposium on a World of Wireless, Mobile and Multimedia Networks, (WoWMoM)	Conference	1
World Scientific and Engineering Academy and Society (WSEAS)	Conference	1
International Conference of Product Focused Software Development and Process Improvement (Profes)	Conference	1
The Swedish Network for European Studies (SNES)	Conference	1
Society for Clinical Data Management (SCDM)	Conference	1
Software Engineering and Advanced Applications (SEAA)	Conference	2
International Conference on Software Engineering and Formal Methods (SEFM)	Conference	1
Scottish Educational Research Association (SERA)	Conference	1
Special Interest Group on Computer-Human Interaction (SIGCHI)	Conference	2
Special Interest Group on Computer Science Education (SIGCSE)	Conference	1
International Conference on Human-Computer Interaction in Business (HCIB)	Conference	1

Table 4.1 Distribution of publication fora (cont.)

Publication Fora	Type	#
International Conference on Human-Centered Software Engineering (HCSE)	Conference	5
Hawaii International Conference on System Sciences (HICSS)	Conference	3
Networking and Parallel/Distributed Computing (SNPD)	Conference	1
International Spice Conference	Conference	1
International Conference on Ubiquitous Intelligence and Computing (UIC/ATC)	Conference	1
International Conference on Usability and Internationalization (UI-HCII)	Conference	1
International Workshop on Usability and Accessibility Focused Requirements Engineering (UsARE)	Conference	1
International Conference on Advanced Communications Technology (ICACT)	Conference	1
International Conference on Biometrics and Kansei Engineering (ICBAKE)	Conference	1
International Conference on Computer and Information Sciences (ICCOINS)	Conference	1
International Conference on Enterprise Information Systems (ICEIS)	Conference	1
International Conference on Information and Computer Technology (ICICT)	Conference	1
International Conference on Information Systems Engineering (ICISE)	Conference	1
International Conference on Computing, Networking and Communication (ICNC)	Conference	1
The International Conference on Software Engineering (ICSE)	Conference	1
International Conference on Software Testing, Verification and Validation (ICST)	Conference	1
The Institute for Excellence in Education (IEE)	Conference	1
International Federation for Information Processing Technical Committee (IFIP TC)	Conference	2
Interaction Homme-Machine (IHM)	Conference	1
The International Institute of Tropical Agriculture (IITA)	Conference	1
International MultiConference of Engineers and Computer Scientists (IMECS)	Conference	1
International Conference on Software Engineering and Formal Methods (SEFM)	Conference	1
Advances in Computer-Human Interactions (ACHI)	Conference	2
INTERACT	Conference	2
The Intergovernmental Panel on Climate Change (IPCC)	Conference	2
International Visual Informatics Conference 2015 (IVIC)	Conference	1
International Workshop on Software Measurement (IWSM-MENSURA)	Conference	1
Conference of Mennonite Brethren (MB)	Conference	1
Multimedia, Interaction, Design and Innovation Conference (MIDI)	Conference	1
The Association for Contemporary Iberian Studies (ACIS)	Conference	2
ASSETS Conference	Conference	1
British Computer Society Conference on Human-Computer Interaction (BCS-HCI)	Conference	1
Nordic Conference on Human-Computer Interaction (NordiCHI)	Conference	10
International Conference on Advanced Information Systems	Conference	1
The Orange County Swim Conference (OCSC)	Conference	1
International Journal of Human-Computer Studies	Journal	5
Proceedings of the Human Factors and Ergonomics Society Annual Meeting	Journal	2

Table 4.1 Distribution of publication fora (cont.)

Publication Fora	Type	#
Behaviour & Information Technology	Journal	3
Interactions	Journal	5
Journal of Systems and Software	Journal	2
Professional Communication, IEEE Transactions	Journal	1
NEC Technical Journal	Journal	1
Software Process: Improvement and Practice	Journal	3
International Journal of Human-Computer Interaction	Journal	2
Journal of Software Engineering	Journal	2
Software: Practice and Experience	Journal	1
Agile Usability Journal	Journal	4
Advances in Human-Computer Interaction archive	Journal	1
Journal of Computer Science and Technology	Journal	2
Health Informatics Journal	Journal	1
Advances in Software	Journal	1
Universal Access in the Information Society	Journal	1
Ubiquitous Information Technologies and Applications book chapter	Book Chapter	1
Technologies for Business Information Systems	Book Chapter	1
Maturing Usability	Book Chapter	1
Measuring Usability - Balancing Agility and Formality	Book Chapter	1
HCI and Usability for Education and Work	Book Chapter	1
HCI and Usability for e-Inclusion	Book Chapter	2
Human Interaction with Complex Systems	Book Chapter	1
Total		170

The majority is published in outlets that belong the area of HCI. Of the 125 conference papers, 116 conferences articles are published in areas that belong to HCI. Of the 36 journal articles, 31 journal articles are published in the area of HCI. Also, all the published book chapters belong to the area of HCI. However, a few of the studies are published in areas that belong to software engineering. 4 journal articles are published in the area of software engineering. 2 of them are published in 2003 about Software Process, and the other 2 journal articles about Systems and software are published in 2010 and 2015. 9 conference articles are published in the area of software engineering. 2 of them are published early, one in 1995 about System science, and another in 1999 about Software development. The rest of the conferences articles are published from 2010 and later within different areas such as Software testing, verification and validation, Software process improvement and capability determination, System sciences, Soft computing and data mining, and Software engineering and advanced applications.

4.2 Contribution type, research type and focus facet

Table 4.2 classify the publications into *contribution facet*, *research type facet* and *focus facet* about UX in software engineering. The result shows that the majority, 51% of the studies, are about *process management*, and *managerial and organizational*, but only 9% are about *tools and technologies*. The studies about *process management* focus on extreme programming, rapid development, scrum, small releases, lean, agile, and highly iterative process. The studies about *managerial and organizational* focus on project management, collect metrics, collective code ownership, release planning, skilled team, and working experience. The studies about *tools and technologies* focus on use of whiteboards, wiki, simple tools and open source components.

Table 4.2 Systematic map overview

1st Author (year)	Research Type	Contribution	Focus
Gulliksen (2003)	Evaluation research	Tool	Managerial/Organizational
Nebe (2011)	Philosophical papers	Framework/methods	Managerial/Organizational
Detweiler (2007)	Experience papers	Lesson learned	Managerial/Organizational
Wolkerstorfer (2010)	Experience papers	Advice/Implications	Managerial/Organizational
Abdulhak (2013)	Experience papers	Lesson learned	Managerial/Organizational
Anderson (2007)	Experience papers	Advice/Implications	Managerial/Organizational
Haesen (2008)	Evaluation Research	Framework/methods	Managerial/Organizational
Haesen (2008)	Philosophical papers	Framework/methods	Managerial/Organizational
Kuusinen (2014)	Evaluation research	Theory	Managerial/Organizational
Larusdottir (2014)	Opinion papers	Guidelines	Managerial/Organizational
Friedland (2007)	Experience papers	Lesson learned	Managerial/Organizational
Rajanen (2013)	Evaluation research	Framework/methods	Managerial/Organizational
Friedland (2005)	Opinion papers	Lesson learned	Managerial/Organizational
Potsus (2001)	Opinion papers	Guidelines	Managerial/Organizational
de Oliveira (2014)	Evaluation research	Guidelines	Managerial/Organizational
Tanikawa (2014)	Evaluation research	Model	Managerial/Organizational
Kanako (2013)	Experience papers	Lesson learned	Managerial/Organizational
Miki (2013)	Philosophical papers	Framework/methods	Managerial/Organizational
Henke (2004)	Experience papers	Lesson learned	Managerial/Organizational
Kumar (2010)	Experience papers	Lesson learned	Managerial/Organizational
McCain (1996)	Evaluation research	Framework/methods	Managerial/Organizational
Zheng (2011)	Experience papers	Tool	Managerial/Organizational
Ashley (2005)	Evaluation research	Guidelines	Managerial/Organizational
Hakiel (1999)	Evaluation research	Guidelines	Managerial/Organizational
Ralph (2014)	Experience papers	Lesson learned	Managerial/Organizational
Gorlenko (2006)	Evaluation research	Model	Managerial/Organizational

Table 4.2 Systematic map overview (cont.)

1st Author (year)	Research Type	Contribution	Focus
Lievesley (2006)	Experience papers	Guidelines	Managerial/Organizational
Gruen (2002)	Solution proposal	Model	Managerial/Organizational
Varsaluoma (2014)	Evaluation research	Framework/methods	Managerial/Organizational
Isomursu (2012)	Philosophical papers	Lesson learned	Managerial/Organizational
Silva (2015)	Philosophical paper	Lesson learned	Managerial/Organizational
Law (2014)	Experience papers	Lesson learned	Managerial/Organizational
Vasmatzidis (2001)	Experience papers	Framework/methods	Managerial/Organizational
Heiskari (2009)	Solution proposal	Lesson learned	Managerial/Organizational
M Hellman (2008)	Philosophical papers	Guidelines	Managerial/Organizational
Masip (2011)	Solution proposal	Advice/implications	Managerial/Organizational
Da silva (2011)	Evaluation research	Lesson learned	Managerial/Organizational
Ferreira (2010)	Philosophical papers	Lesson learned	Managerial/Organizational
Brauer (2014)	Evaluation research	Lesson learned	Managerial/Organizational
Budwig (2009)	Experience papers	Lesson learned	Managerial/Organizational
Bias (2013)	Opinion papers	Lesson learned	Managerial/Organizational
Egh (2008)	Evaluation research	Lesson learned	Managerial/Organizational
Vredenburg (2002)	Evaluation research	Lesson learned	Managerial/Organizational
Meingast (2013)	Opinion paper	Lesson learned	Managerial/Organizational
Ferreira (2012)	Experience paper	Framework/method	Managerial/Organizational
Ferreira (2012)	Opinion papers	Advice/implications	Managerial/Organizational
Ferreira (2007)	Experience papers	Lesson learned	Managerial/Organizational
Kuusinen (2012)	Solution proposal	Lesson learned	Managerial/Organizational
Hussain (2008)	Experience papers	Lesson learned	Managerial/Organizational
Schwartz (2014)	Experience paper	Lesson learned	Managerial/Organizational
Egh (2008)	Experience papers	Advice/implications	Managerial/Organizational
Lester (2011)	Evaluation research	Lesson learned	Managerial/Organizational
Hussain (2009)	Evaluation research	Lesson learned	Managerial/Organizational
Khodadadeh (2009)	Evaluation research	Lesson learned	Managerial/Organizational
Brhel (2015)	Evaluation research	Lesson learned	Managerial/Organizational
Yamakami (2012)	Opinion papers	Guideline	Managerial/Organizational
Kuusinen (2012)	Experience papers	Advice/implications	Managerial/Organizational
Kuusinen (2014)	Experience papers	Lesson learned	Managerial/Organizational
Düchting (2007)	Opinion paper	Lesson learned	Managerial/Organizational
Jurca (2014)	Evaluation research	Guidelines	Managerial/Organizational
Salah (2014)	Evaluation research	Model	Managerial/Organizational
Felker (2012)	Experience paper	Lesson learned	Managerial/Organizational
Komischke (2009)	Experience paper	Guideline	Managerial/Organizational
Viikki (2011)	Experience paper	Lesson learned	Managerial/Organizational
Kuusinen (2015)	Solution proposal	Theory	Managerial/Organizational
Yan (2015)	Opinion paper	Frameworks/methods	Managerial/Organizational

Table 4.2 Systematic map overview (cont.)

1st Author (year)	Research Type	Contribution	Focus
van(2015)	Philosophical paper	Guidelines	Managerial/Organizational
Di (2015)	Evaluation Research	Theory	Managerial/Organizational
Springett (2015)	Philosophical paper	Model	Managerial/Organizational
Vukelja (2010)	Evaluation research	Lesson learned	Managerial/Organizational
Ploskonos (2008)	philosophical papers	lesson learned	Managerial/Organizational
Badham (1995)	Experience papers	lesson learned	Managerial/Organizational
Hokkanen (2015)	Philosophical paper	Lesson learned	Process Management
Gonzalez (2015)	Evaluation Research	Guidelines	Process Management
Silva (2015)	Opinion paper	Lesson learned	Process Management
Wale (2015)	Experience paper	Guidelines	Process Management
Salah (2015)	Evaluation Research	Guidelines	Process Management
Ogunyemi (2014)	Evaluation research	Framework/methods	Process management
Hussain (2009)	Evaluation research	Model	Process management
Ardito (2014)	Evaluation research	Guidelines	Process management
Begior (2007)	Experience papers	Framework/methods	Process management
Law (2010)	Experience papers	Lesson learned	Process management
Liikkanen (2014)	Solution proposal	Framework/methods	Process management
Solanki (2013)	Experience papers	Lesson learned	Process management
Adikari (2009)	Evaluation research	Framework/methods	Process management
Viorres (2007)	Solution proposal	Framework/methods	Process management
Rauschenberger (2012)	Experience papers	Tool	Process management
Joshi (2010)	Evaluation research	Framework/methods	Process management
Lai (2006)	Experience papers	Lesson learned	Process management
Winter (2009)	Evaluation research	Model	Process management
Maguire (2001)	Evaluation research	Lesson learned	Process management
Ruthford (2002)	Evaluation research	Model	Process management
Bobkowska (2013)	Evaluation research	Framework/methods	Process management
Terry (2010)	Evaluation research	Model	Process management
Caballero (2014)	Experience papers	Tool	Process management
Gon (2011)	Evaluation research	Framework/methods	Process management
Hussain (2012)	Experience papers	Lesson learned	Process management
Popli (2014)	Evaluation research	Lesson learned	Process management
Constantine (2002)	Evaluation research	Framework/methods	Process management
Players (2001)	Evaluation research	Framework/methods	Process management
Tanikawa (2014)	Evaluation research	Guidelines	Process management
Adikari (2013)	Philosophical papers	Framework/methods	Process management
Ronkko (2008)	Experience papers	Lesson learned	Process management
Obendorf (2008)	Experience papers	Tool	Process management
Clemmensen (2003)	Experience papers	Lesson learned	Process management
Barksdale (2013)	Evaluation research	Framework/methods	Process management

Table 4.2 Systematic map overview (cont.)

1st Author (year)	Research Type	Contribution	Focus
Parsons (2007)	Evaluation research	Framework/methods	Process management
Ambler (2008)	Philosophical papers	Framework/methods	Process management
Lrusd (2012)	Experience papers	Framework/methods	Process management
Nass (2010)	Evaluation research	Model	Process management
van der (2001)	Evaluation research	Framework/methods	Process management
Seffah (2004)	Experience papers	Framework/methods	Process management
Fø lstad (2010)	Experience papers	Framework/methods	Process management
Alves (2014)	Opinion papers	Model	Process management
Gransson (2003)	Philosophical papers	Framework/methods	Process management
Chamberlain (2006)	Evaluation research	Lesson learned	Process management
Butt (2014)	Philosophical papers	Framework/methods	Process management
Lee (2007)	Opinion papers	Guidelines	Process management
Najafi (2008)	Solution proposal	Model	Process management
Jokela (2010)	Experience papers	Lesson learned	Process management
Gulliksen (2003)	Solution proposal	Advice/Implications	Process management
Ahmad (2013)	Evaluation Research	Framework/methods	Process management
Constantine (2003)	Philosophical papers	Framework/methods	Process management
Singh (2008)	Solution proposal	Lesson learned	Process management
Granollers (2003)	Solution proposal	Framework/methods	Process management
Ferreira (2011)	Evaluation research	Framework/methods	Process management
Joshi (2008)	Experience papers	Framework/methods	Process management
Kropp (2014)	Experience papers	Lesson learned	Process management
Al-Badareen (2011)	Philosophical papers	Model	Process management
Treviranus (2009)	Solution proposal	Lesson learned	Process management
Faulring (2012)	Evaluation research	Tool	Process management
Winter (2007)	Solution proposal	Model	Process management
Peixoto (2009)	Solution proposal	Framework/method	Process management
Martella (2014)	Evaluation Research	Framework/method	Process management
Dino (2013)	Solution proposal	Framework/method	Process management
Tan (2013)	Solution proposal	Framework/method	Process management
Schulze (2011)	Solution proposal	Framework/method	Process management
Juristo (2007)	Philosophical papers	Framework/method	Process management
Xiong (2010)	Experience papers	Model	Process management
Williams (2013)	Evaluation research	Tool	Process management
Deryckere (2008)	Experience papers	Tool	Process management
Lee (2013)	Evaluation research	Tool	Process management
Peng (2009)	Evaluation research	Guideline	Process management
Humayoun (2011)	Philosophical paper	Tool	Process management
Memmel (2007)	Philosophical papers	Framework/method	Process management

Table 4.2 Systematic map overview (cont.)

1st Author (year)	Research Type	Contribution	Focus
Fox (2008)	Experience papers	Framework/method	Process management
Adikari (2013)	Evaluation research	Framework/method	Process management
Abduljalil (2011)	Evaluation research	Model	Process management
Yamazaki (2007)	Experience papers	Framework/method	Process management
Specker (2007)	Opinion papers	Framework/method	Process management
Jin (2014)	Solution proposal	Framework/method	Process management
Ferre (2003)	Solution proposal	Framework/method	Process management
Ovad (2015)	Experience paper	Guidelines	Process management
Kuusinen (2015)	Philosophical paper	Lesson learned	Process management
Choma (2015)	Experience paper	Guidelines	Process management
Lima (2015)	Philosophical paper	Framework/methods	Process management
Seyam (2015)	Solution proposal	Theory	Process management
Zapata (2015)	Experience paper	Guidelines	Process management
Silva (2015)	Evaluation Research	Frameworks/methods	Process management
Law (2015)	Experience paper	Lesson Learned	Process management
Weber (1998)	Evaluation research	Tool	Tools and Technology
Nieters (2007)	Philosophical papers	Tool	Tools and Technology
Constantine (1996)	Philosophical papers	Framework/methods	Tools and Technology
Scholtz (2003)	Solution proposal	Framework/method	Tools and technology
Ma (2007)	Experience papers	Tool	Tools and technology
Canfora (2013)	Experience papers	Tool	Tools and technology
Paay (2007)	Experience papers	Theory	Tools and technology
Hastreiter (2014)	Solution proposal	Framework/method	Tools and technology
Butt (2014)	Evaluation research	Model	Tools and technology
Chek (2015)	Experience paper	Guidelines	Tools and technology

Based on the results from the classification schema, the author presents the systematic map with multi-dimensional bubble charts as suggested by Petersen et al. [2] to provide an overview of how UX in software engineering has been researched. The overview helps to identify potential gaps and needs for further research about UX in software engineering. In the bubble chart, x–y scatter plots with bubbles in categories intersections, where the number of publications corresponding to the x–y coordinates determine the size of the bubble [2, 18]. The same idea is used two times, in different quadrants in the same diagram to show the intersection with the third facet. The bubble chart in Figure 4.3 shows the *research type facet* and *contribution facet* in the x-axis, and the *focus facet* used in the y-axis from the classification schema, which results in a complete overview of the systematic map and providing means to analyze it.

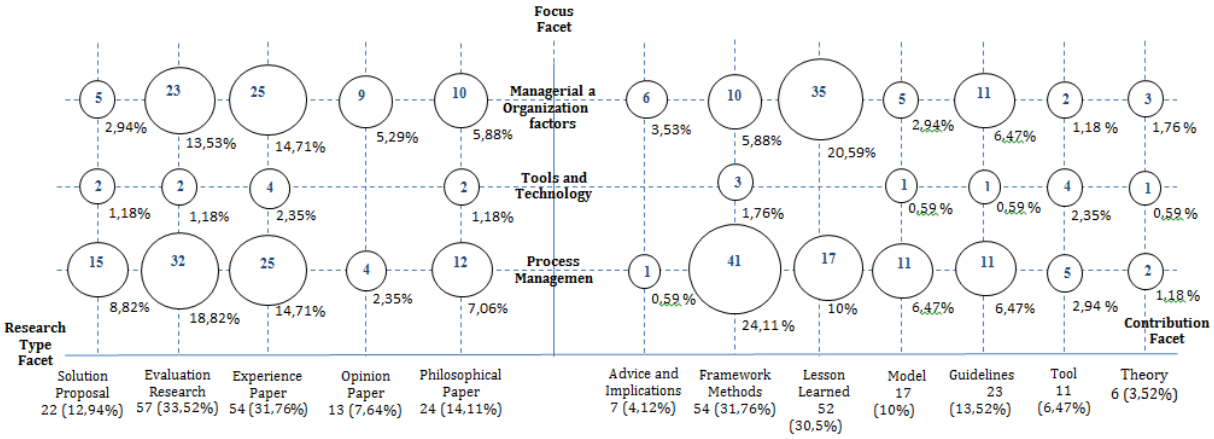

Figure 4.3. Systematic map – focus, contribution and research type

Contribution Facet Vs Focus Facet:

The *contribution facet* is classified as *advice and implications, framework/methods, lesson learned, model, guidelines, tool,* and *theory* (see table 3.5). The *focus facet is* classified as *managerial and organizational, tools and technology,* and *process management* (see table 3.6). To identify the gaps in the *focus facet*, the author first refers to the classification of the *contribution facet* in the x-axis and then the *focus facet* in the y-axis for the 170 publications. The result shows that 54 studies are about *framework/methods*, 52 studies are about *lesson learned*, 23 studies are about *guidelines*, 17 studies are about *model*, and 11 studies are about *tool*. The two smaller categories are about *advice and implications* 7 studies, and about *theory* 6 studies.

In the category *managerial and organizational*, the majority, 35 of the studies are about *lesson learned*. 11 studies are about *guidelines*, 10 studies are about *framework/methods*, 6 studies are about *advice and implications*, and 5 studies are about *model*. The two smaller categories are about *theory* 3 studies, and about *tools* 2 studies.

In the category *process management*, the majority, 41 of the studies are about *framework/methods*. 17 studies are about *lesson learned*, 11 studies are about *model* and *guidelines*, and 5 studies are about *tool*. The two smallest categories are about *theory*, 2 studies, and about *advice and implications*, 1 study.

In the category *tools and technology*, the result shows very few publications in total. 4 studies are about *tools*, 3 studies are about *framework/methods*, 1 study is about *model*, 1 study is about *guidelines*, and 1 study is about *theory*. The systematic map shows that no articles are published so far about *advice and implications*, and *lesson learned* in *tools and technology*. The result shows that limited papers are published

about *tools and technology* compared with *managerial and organizational*, and *process management in research about UX in software engineering*.

Research Facet Vs Focus Facet:

The category *research type facet* is classified as *solution proposal, evaluation research, experience papers, opinion papers,* and *philosophical papers (see table 3.4)*. To identify the gaps in the *focus facet*, the author refers the *focus facet* in y-axis with the results from *research type facet* in the x-axis. The result shows that 57 studies are *evaluation research*, and 54 studies are *experience papers*. 24 studies are *philosophical papers*, and 22 studies are *solution proposal*. The smallest category is *opinion papers* about UX in software engineering that consist of 13 studies.

In the category *managerial and organizational*, the majority, 25 of the studies are *experience paper*. 23 studies are *evaluation research*, 10 studies are *philosophical papers*, 9 studies are *opinion paper*. The smallest category is *solution proposal* that consist of 5 studies.

In the category *process management*, the majority, 32 of the studies are *evaluation research*. 25 studies are published as *experience papers*, 15 studies are published as *solution proposal,* and 12 studies are published as *philosophical papers*. The smallest category is *opinion papers* that consists of 4 studies.

The overall result from the *focus facet*, the *contribution facet, and the research type facet* bubble chart clearly shows a gap of publications about *tools and technology* about UX in software engineering (see Figure 4.3).

4.3 What domains have been studied

This section answers the third research question to find what domains have studies been conducted about UX in software engineering. The bubble chart in Figure 4.4 shows the r*esearch type facet* and *domains* in the x-axis and the *contribution facet* used in the y-axis. The empirical research studies in the industries are classified as a certain '*domain*', and literature review studies such as mapping study, scoping study are classified as 'no specific domain'. The *domain* is classified as *mobile, sales, online games, manufacturing, telecom, medical, insurance, automotive,* and *aviation*. The result shows that 61 studies can be categorized into different *domains*, but the majority, 109 of the studies are literature reviews, conceptual papers, or scoping studies and hence, these are all categorized as '*no specific domain*'.

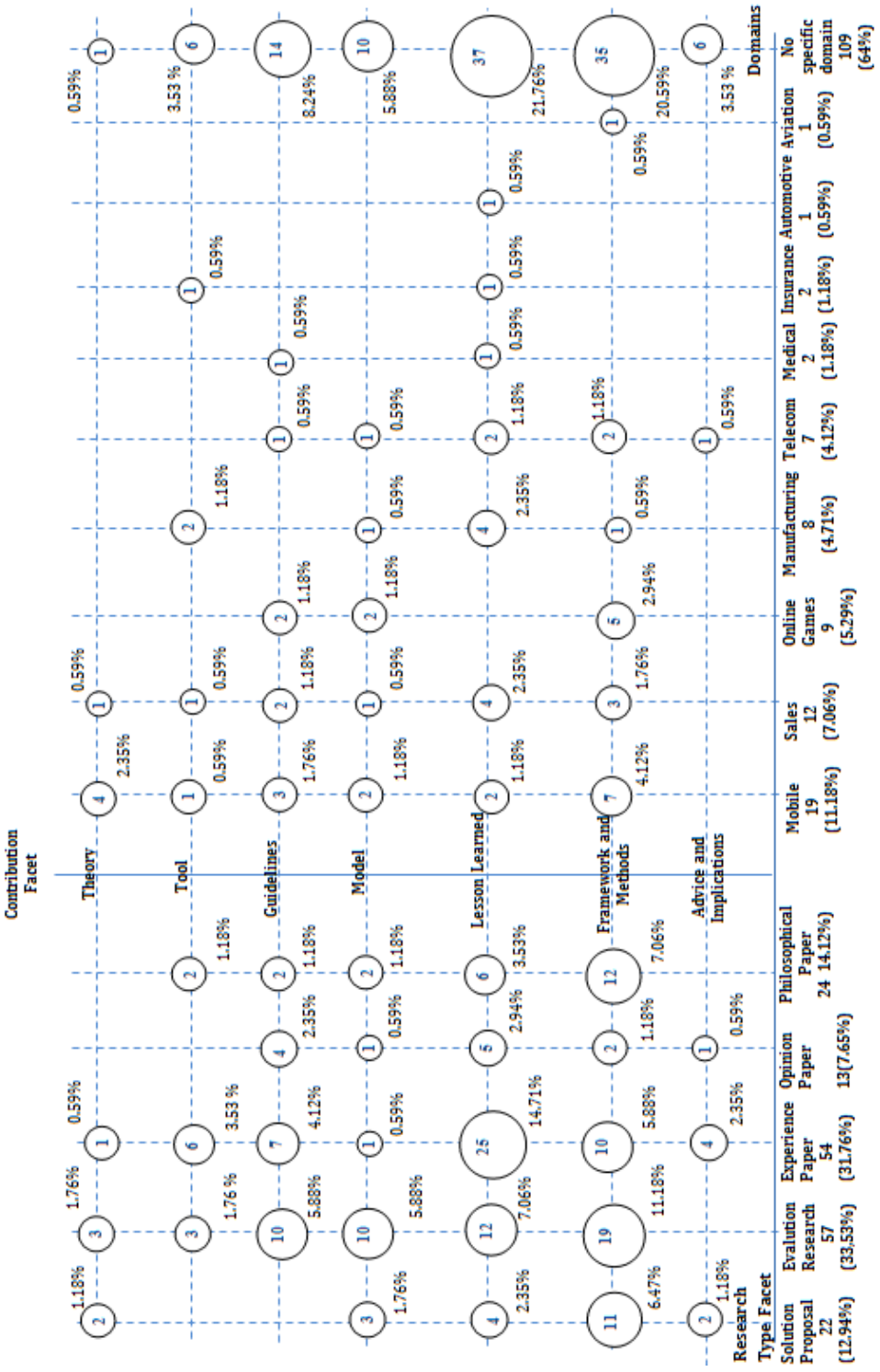

Figure 4.4. Systematic map – Domain, contribution and research type

Domain Vs Contribution Facet:

The result shows that the majority, 19 of the studies are about *mobile,* 12 studies are about *sales*, 9 studies are about *online games*, 8 studies are about *manufacturing*, and 7 studies are about *telecom*, 2 studies are about *medical* and *insurance.* The smallest category are *automotive* and *aviation* that consists of 1 study.

In the category *mobile,* the majority, 7 of the studies are about *framework/methods,* 4 studies are about *theory,* 3 studies are about *guidelines,* 2 studies are about *model* and *lesson learned*. The smallest category is *tool* that consists of 1 study. There are no studies about *advice and implications*.

In the category *sales,* 4 studies are about *lesson learned,* 3 studies are about *framework/methods,* 2 studies are about *guidelines,* 1 study is about *model,* 1 study is about *tool,* and 1 study is about *theory*. However, there are no studies about *advice and implications*.

In the category *manufacturing*, 4 studies are about *lesson learned,* 2 studies are about *tool,* 1 study is about *model,* and 1 study is about *framework/methods*. However, there are no studies about *theory, guidelines,* and *advice and implications.*

In the category *telecom*, 2 studies are about *framework/methods,* 2 studies are about *lesson learned,* 1 study is about *model,* 1 study is about *guidelines,* and 1 study is about *advice and implications.* However, there are no studies about *tool* and *theory.*

In the category *online games,* 5 studies are about *framework/methods,* 2 studies are about *model* and 2 studies are about *guidelines*. However, there are no studies about *theory, tools, lesson learned,* and *advice and implications*.

In the category *insurance*, 1 study is about *tool,* and 1 study is about *lesson learned.* However, there are no studies about *theory, guideline, model, framework/methods,* and *advice and implications*.

In the category *medical*, 1 study is about *guidelines* and 1 study is about *lesson learned.* However, there are no studies about *theory, tool, model, framework/methods,* and *advice and implications*.

In the category *automotive*, 1 study is about *lesson learned*. However, there are no studies about *advice and implications, framework/methods, model, guidelines, tool,* and *theory.*

In the category *aviation*, 1 study is about *framework/methods*. However, there are no studies about *advice and implications, lesson learned, model, guidelines, tool,* and *theory*.

In the category *no specific domain*, the majority, 37 of the studies are about *lesson learned* focusing on HCI, usability, UCD. 35 studies are about *framework/methods* focusing on HCI,

usability, User involvement, UCD, User-centred design, Usage-centered design, HCD. 14 studies are about *guidelines* focusing on UCD and usability. 10 studies are about *model*, 6 studies are about *tool*, and 6 studies are about *advice and implications*. The smallest category is *theory* that consists of 1 study focus on usability.

Research Type Facet Vs Contribution Facet:

To identify the gaps in the *research type facet*, the author refers the *contribution facet* in y-axis with the results from *research type facet* in the x-axis. The result shows that the majority of the studies are *evaluation research* (20 studies). In the category *evaluation research,* 7 studies are about *online games,* 5 studies are about *manufacturing* , 3 studies are about *mobile,* 2 studies are about *sales,* 2 studies are about *medical,* and 1 study is about *telecom.*

In the category *experience papers*, 7 studies are about *mobile,* 6 studies are about *sales,* 3 studies are about *telecom*, 2 studies are about *manufacturing* and 2 studies are about *insurance,* 1 study is about *online games,* and 1 study is about *automotive* domains.

In the category *philosophical papers*, 3 studies are about *mobile,* 1 study is about *manufacturing,* 1 study is about *online games,* 1 study is about *sales* and 1 study is about *telecom.*

In the category *solution proposal*, 4 studies are about *mobile.* 3 studies are about *sales,* 2 studies are about *telecom,* and 1 study is about *aviation*. In the category *opinion papers,* 3 studies are about *mobile*.

The overview of the result from Figure 4.4 shows that in the category *contribution facets,* many studies are published about *framework/methods, lesson learned,* and *model,* and in the category *research type facets,* studies are published in various domains. While the majority of the studies focus on *guidelines,* only a few studies focus *advice and implications, tool* and *theory*. Studies about *advice and implications* are published only in the category *telecom*. Based on the existing empirical studies, the result shows that UX studies in software engineering have mainly been conducted in the domains *mobile, sales, online games, manufacturing, telecom, medical, insurance, automotive,* and *aviation*. A few studies have been conducted in the domains *medical, insurance, automotive* and *aviation*. However, many domains are absent such as education, banking and defense.

4.4 UX tools used in different software development phases

This section answers the fourth research question about what *tools* are used in the category of software development phases such as *business planning, requirement, development* and *testing*. Figure 4.3 in section 4.2 shows that only 6% of the studies is published about *tool*.

The bubble chart in Figure 4.5 shows studies that focus on tools and in which software development phase these tools are addressing. The bubble chart use *research type facet* in the y-axis, and *tool* in the x-axis.

The results show that the majority, 4 of the studies are about *development*. 3 studies are about *requirement*, 3 studies are about *testing*, and 1 study is about *business planning*.

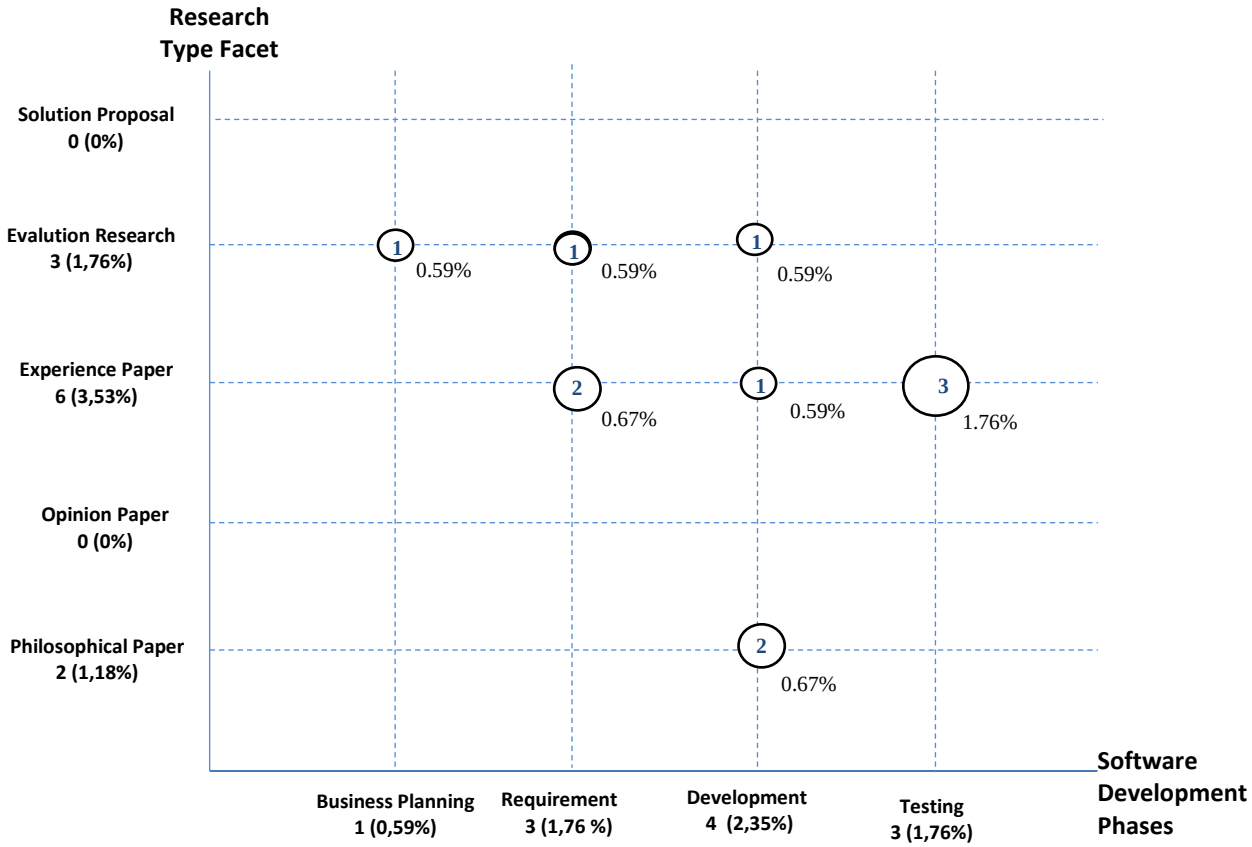

Figure 4.5. Systematic map – Software development phases and research type

In the category *experience paper*, the majority, 3 of the studies are about *testing*, 2 studies are about *requirement*, 1 study is about *development*. However, there are no studies about *business planning*. In the category *evaluation research*, 1 study is about *business planning*, 1 study is about *requirement*, 1 study is about *development*. However, there are no studies about *testing*. In the category *philosophical papers*, 2 studies are about *development*. However, there are no studies about *business planning*, *requirement, and testing*. Also, in the category *solution proposal*, and *opinion papers*, the result shows no studies about *business planning, requirement, development and testing*.

The result shows that the majority of the studies are about *development, testing* and *requirement phases*. However, few studies are about *business planning* in the software development phases. 11 studies in software development phases discuss the various *tools* such as Powerpoint, Visio, SketchFlow, Flash Catalyst, Expression Design, Adobe Illustrator,

Photoshop, Visual Studio, Flash Builder, Expression Blend, UEMan, SiMUlator, Flash Builder, Scenarios, Personas, Gateway Visual Studio tool, Excel, BenchMark tools (like Quadrant, AnTuTu and Smartbench), and Microsoft Office. The overall result from bubble chart clearly shows a gap in the publication of *tools* about UX in software engineering.

4.5 Distribution of UX studies in agile and non-agile methodologies

This section answers the last research question about how UX studies are distributed between agile and non-agile methodologies about UX in software engineering.

The bubble chart in Figure 4.6 shows the *research type facet* and *agile and non-agile* in the x-axis, and the *contribution facet* used in the y-axis. The result shows that majority, 110 of the studies are about *non-agile*, and 60 studies are about *agile*. In the category *agile*, 50 studies are about agile, 3 studies are about eXtreme Programming (XP), 5 studies are about scrum, 1 study is about Kanban.

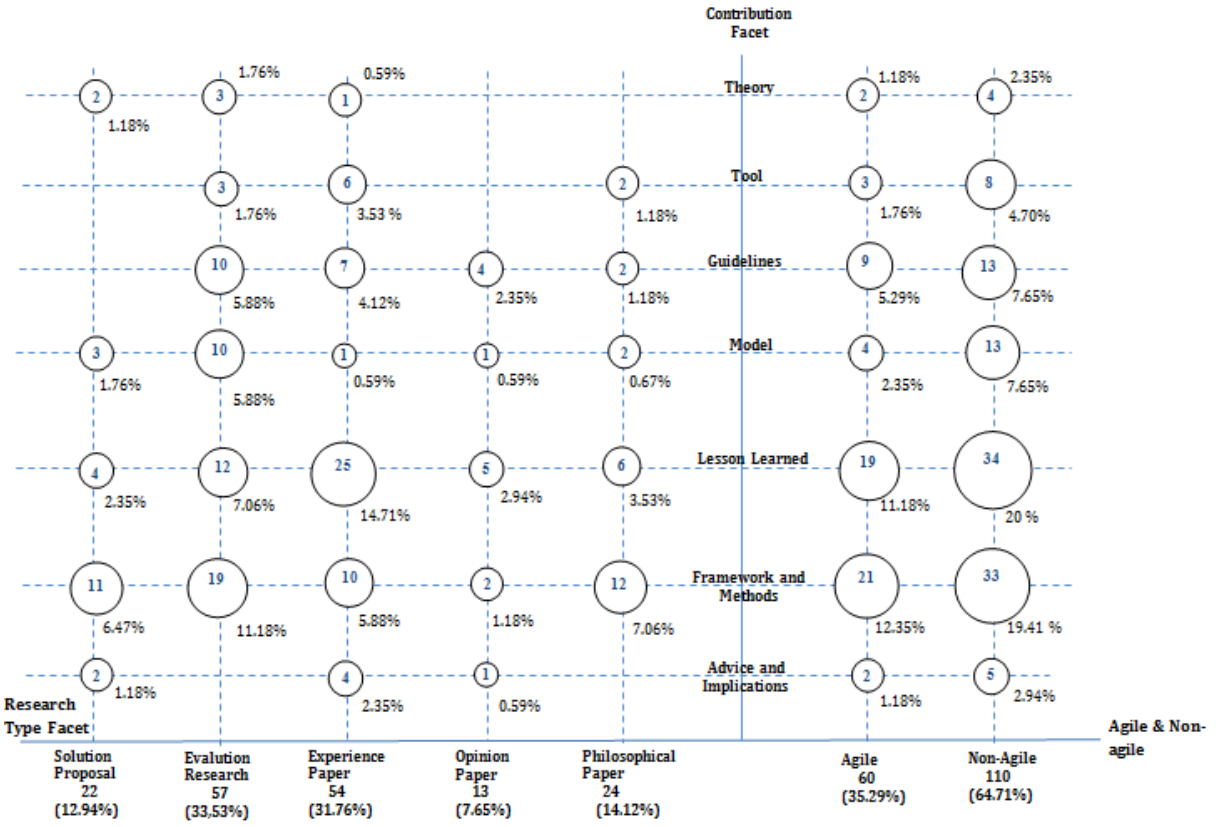

Figure 4.6. Systematic map - Contribution, Agile & Non-Agile, and Research Type

In the category *agile*, the majority, 21 of the studies are about *framework/methods*, 19 studies are about *lesson learned*, 9 studies are about *guidelines*, 4 studies are about *model*, 3 studies are about *tool*.

In the category *non-agile*, the majority, 34 of the studies are about *lesson learned*, 33 studies are about *framework/methods*, 13 studies are about *model*, 13 studies are about *guidelines*, 8 studies are about *tools*, and 5 studies are about *advice and implication*. The smallest category is *theory* that consists of 4 studies. The result shows that the majority of the studies are about *evaluation research* and *experience papers*. In the category *experience paper*, 20 studies are about *agile* focus on UX, usability, and UCD. 31 studies are about *non-agile*.

In the category *evaluation research*, 15 studies are about *agile* focusing on UX, HCD and UCD. 42 studies are about *non-agile*. In the category *philosophical paper*, 9 studies are about *agile*, 15 studies are about *non-agile* focusing on usability, UCD, HCD, HCI and UX. In the category *solution proposal*, 9 studies are about *agile* focusing on UX and usability, 13 studies are about *non-agile*. In the category *opinion paper*, the result shows that 6 studies are about *agile* focusing on UX and usability, 7 studies are about *non-agile* focusing on UX and usability. The overview of the result from Figure 4.6 shows that in the category *agile* and *non-agile*, many studies are published about *framework/methods* and *lesson learned*. However, few studies are about *theory* and *advice and implications*. The number of studies about *tools* are more in the category *non-agile* than *agile*. The result shows a gap of *solution proposal* and *opinion papers*.

5

Discussion

This section discusses the results presented in section 4 with related research. The section is structured based on the five research questions. The section ends with a discussion about implications of the findings for research and practice.

5.1 Frequency of publications

The research about UX in software engineering has gained interest in the software engineering research community in recent years. The results from Figure 4.1 shows a limited number of publications about UX in software engineering until 2006, and for example none of the studies has focused on UX *theory* until 2006. Before 2007, only 16 conference articles are published and the majority of these are published in the area of HCI. Only 2 of the conference articles are published in areas that belong to software engineering such as system development and system sciences. The majority of the conference articles and journal articles were published starting from 2007, and from that time an increasing number of studies have been carried out about UX in software engineering. One of the reasons for this is that mobile systems have in the same period received more attention from the software industries [5].

The result from the characterization of primary studies (see Figure 4.2) shows that the majority is about the importance of UX using related concepts such as Usability, User-Centered Design, Human-Centered Design, and HCI. According to ISO 9241-11 (1998), usability is the *"extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use"*. Ogunyemi et al. [69] discuss that organisational culture, context of application of HCI techniques, user involvement, usability evaluation techniques, and software engineering modeling techniques are the areas which need to be addressed to fulfill the gaps between the HCI and software engineering. The majority of the studies about usability are published starting from 2007. Most of them, 83%, are even published in the last 3-4 years.

Similar to usability, the majority of the studies about User-Centered Design are published from 2007, and most of them, 50%, are published in the year 2008 and 2014. According to ISO 13407, User-Centered Design is defined as "*design is based upon an explicit understanding of users, tasks and environments, users are involved throughout design and development, design is driven and refined by user-centered evaluation, and the process is iterative and the design team includes multidisciplinary skills and perspectives*". User-Centered Design is a framework to provide positive UX. According to Kropp and Koischwist [68] User-Centered Design allows requirements engineering to focus on UX, as well as their needs and expectations. Moreover, User-Centered Design activities can help to check whether requirements are fulfilled, and the quality of the solution provides good UX [68].

The results from the study show that most of the studies about UX are published in areas that belong to HCI. The definition of UX and its relationship to HCI is complex [48]. According to Kuniavsky, UX and HCI share boundaries with a number of other subjects and fields as well as with each other. For example, they share boundaries with anthropology, cognitive psychology, industrial design and computer science in practice, as well as with customer relationship management and marketing because all of these play an important role in actual day-to-day experiences with products and services [48], which are core aspects of both UX and HCI. The non-involvement, or lack of involvement, of the actual users in the software products design and development process, is a demonstration of the transfer problems between the HCI and software engineering [69]. The goal of HCI technology is to develop safe and usable products in software development in order to reach user satisfaction. UX highlights the experiential, affective, meaningful, and valuable aspects of HCI and product ownership [13]. According to Ardito et al. [58], UX extends the most traditional concept of usability, focused primarily on ease-of-use, by emphasizing subjective attributes like esthetics, emotions, and social involvement.

As stated earlier, the results from Figure 4.1 show that while the majority of the studies about UX in software engineering have been published in areas that belong to HCI, the trend seems to be an increasing attention to the topic in areas that belong to software engineering. The statistics show that the frequency of publications about UX has increased from 2007, which has likely to do with the increased attention towards mobile applications and the connection to more user interaction studies in HCI, usability, and User-Centered Design [5].

5.2 Contribution, research type and focus facet

The classification of the studies into *contribution facet, research type facet and focus facet* in Figure 4.3 shows that both *process management* and *managerial and organizational* category papers are discussed in all the categories of *research type facet* and *contribution facet*.

However, the results show that few of the studies are in the category UX *tools and technology*.

The majority of the publications in *process management* are about *framework/methods*. These publications are mainly about user interaction and integration of agile and UX. According to Veer and Vliet [86] in software engineering, the design of the user interface is a separate activity, and not in the mainstream requirements engineering, design, implementation and testing process model. Traditional user interface design mainly concerns the situation of a single user and a monolithic system [86].

Only few studies are about *model* in *process management.* According to Ruthford [84], many usability methods have been developed, and each method includes many techniques that can be used independent of the method. Some of the UX methods are extracted from interview methods, task analysis methods, user-centered design methods, usability engineering methods, and usability testing methods. From an HCI perspective, one of the main problems developers encounter in software design is a lack of experimental research on human factors [25]. Mainly, developers are focused on the quantities and contents of the applications. However, developers are underestimating the importance of UX capabilities [25]. To overcome this problem, Abduljalil and Kang [25], present a new design model in order to enhance and facilitate the design process. Another problem discussed by Ardito et al. [58] is that too many companies either neglect usability and UX, or do not properly address the gap between HCI and software engineering [58]. Cooperative Method Development is an empirical research effort with the aim to reduce the gap between research and practice of usability and UX [58].

Some of the studies in *process management* discuss identified gaps of UX in software engineering [60, 69]. Ogunyemi et al. [69] discuss the organisational culture, context of the application of HCI techniques, user involvement, usability evaluation techniques, and software engineering modeling techniques as the areas that need to be addressed. Jokela [60] suggested that two gaps needs to be addressed, both between UX and interaction design, and between interaction design and software development. UX requirements may be achieved with different kinds of design solutions, and this can be addressed if interaction design solutions meet UX requirements and are easy to implement with software [60].

In the research type *managerial and organizational* category, the majority of the studies are in *evaluation research* and *experience papers* about UX and agile. In the contribution facet, the most studies are about *guidelines* and how to address the gaps between software design and development process. According to Kuusinen [87], understanding the context of the software design and development process is done by formalizing the communication, and increasing the quality of the work within the capabilities of a UX group. Next to the category *guidelines*, the majority of the publications in *managerial and organizational* are about *framework/methods* in usability, User-Centered Design, and HCD.

The systematic mapping result shows that only 2 case studies are conducted on the usage of *tools* with the aim to reduce gaps in the communication between users and developers. In *process management*, and *managerial and organizational* categories, the papers focused on all the *contribution facet* categories.

As stated earlier, only very few studies have been conducted in the category *tools and technology*. The publications in *framework/methods* are about the integration of usability engineering and software engineering in the software-development process. According to Scholtz et al. [77], a number of efforts are being undertaken to integrate usability engineering and software engineering in the software-development process. The publications in the category *model* are about the integration of agile methods with usability, and highlights the critical issues of agile methods and the importance of usability in agile methods. In the category *theory*, there is only 1 study and it is about HCI in mobile applications. The *experience papers* are about HCI and UX, and 50% of these studies are about mobile technologies. The publications in *evaluation research* as well as in *philosophical papers* are about Usability. According to Constantine et al. [82], usability is an important factor often neglected in software engineering. According to Weber [64], standard software engineering methods are not directly applicable to nonvisual user interfaces due to the mismatch of user interfaces for the developers and users. Studies proposed by Butt et al. [41], about the integration of agile and usability are published in *evaluation research.* However, the result of the systematic mapping study shows that no studies are published in the *contribution facets advice and implications* and *lesson learned.*

The results of the systematic mapping study show that only 2 publications are about *theory*. This indicates that UX is not well defined regarding processes and methods to follow as described by Law et al. [43]. The existing publications show that UX has a wide range of meanings and definitions. According to Law et al. [43] there are several reasons why it is hard to get a universal definition of UX. The main reason is that UX is associated with a broad range of fuzzy and dynamic concepts, including emotional, affective, experiential, hedonic, and aesthetic variables [43]. According to Law et al. [43], a definition for UX will facilitate scientific discourse, especially when scholars from multiple disciplines are involved, it will enable managing practical applications of UX, for which UX will need to be operationalized and evaluated against measurements, and it will help the teaching of the notion UX with the fundamental understanding of its nature and scope.

UX is seen as something new, which must be a part of the HCI domain and be grounded in UCD practices [43]. Law et al. [43] point out that four challenges engendered by UX that are particularly relevant to software development, are definition of UX, modeling of UX, selection and application of UX evaluation methods, and interplay between UX evaluation feedback and software development. According to Law et al. [43] the definitions about UX are not clearly defined. Law [78] argues "*although some software developers have some theoretical knowledge of user interface design guidelines or usability standards, they*

seldom use them in practice, simply because they do not know which, when and how to apply them in their context". Also, Law et al. [43] concludes that "*User Experience is still being defined and scoped!*"

The overall results from the study show that the fewest number of studies are about *tools* and *theory*. The result about the *tools and technology* in *focus facet* shows very few studies has been done in the UX *tools*. In total, there are 11 studies about *tools*, published in 2007, 2011 and 2012, 2014, and 2015. Further analysis about *tools* and what kind of UX tools have been used in various software development phases is discussed in section 5.4.

5.3 What domains have been studied

The classification of the studies into *contribution facet, research type facet, and domains* in Figure 4.4 shows that the majority of the studies are about *framework/methods*, *lesson learned*, *model*, and *guidelines*. Few of the studies are about *advice and implications*, *tool*, and *theory*.

As stated earlier, the majority of the studies are in the category *'no specific domain'*. The studies in the category '*domains'* are mainly within mobile industries. Wasserman [80] stated that user interaction have a significant impact on interaction design for mobile applications, which in turn has a strong influence on application development. However, it shows the gap in the publication about *advice and implications* in the category *mobile*.

The result shows that only a few studies are in the domains of *automotive*, *aviation*, *medical* and *insurance*. In the category *automotive*, the studies focus on HCD. According to Viikki et al. [81], even after the HCD is implemented in the *automotive* domain, companies struggle with problems caused by poor usability of their products. Their research study indicates that one of the main success factors for such an approach is that the organizations have relatively strong processes and rule orientation in its culture. They also emphasize that the process development does not lead to organizational change, unless the people actually follow the processes [81].

The usage of common industry format (CIF) in the domain of *aviation* talks about the integration of usability engineering and software engineering in the software-development process [66]. The different fields of usability engineering and software engineering often work together to increase software quality [66]. Usability professionals must accept a role as facilitators who connect developers with stakeholders, and moderate negotiation processes when they threaten to fail [66]. Because usability is a key quality of software, depending on both technical and non-technical factors, ideally, the responsibility needs to be shared [66].

In the domain of *medical*, the study published by Hoegh and Jensen [67] conclude that usability evaluation adds more specific knowledge about the state of a software project, both in terms of the type of usability problems, the amount of usability problems, and the severity of the usability problems. However, developers still reported about additional usability problems they found that had not been experienced in the evaluation with users [67]. Also, a developer may have a different view of what constitutes a usability problem, or simply a differing opinion on actual usability issues in software development, compared to a user [67].

The result from the bubble chart indicates that the UX studies are mainly about the domains of *mobile* and *sales*. As stated earlier, there are some studies in other domains but they are very few in the category of *medical, insurance, automotive* and *aviation*. As mentioned before, the focus of previous research in the domain of *mobile* has been explained by the importance of UX in such devices. However, there might be a need for an additional studies in other domains to understand UX role in other types of applications and *domains*.

5.4 UX tools in software development phases

The result from Figure 4.3 and Figure 4.4 shows that very few of the studies are about the category *tool*. From the primary studies, only 8% of the studies are in the category *tools*. The result from Figure 4.5 shows that few of the studies are about the earlier phase in the development such as *business planning*. In the category *business planning*, only 1 *evaluation research* study by Myers and Rotenberg published about the *tool* called "Gateway VS tool", to provides a wizard-style user interface in which developers design a basic version of their application [55]. Also, few of the *evaluation research* study are in the category *requirement* and *development*.

In the category *requirement*, 2 studies are *experience paper*. Scenarios and Personas are the tools focused on the *requirement*. According to Leydin. [83], the persona tool not only helps HCI designers to develop usable user interfaces, but also agile developers and other stakeholders to elicit the client requirements and to engage the client in the development lifecycle. Also, persona is a flexible technique to be tailored for different development methods, projects and users [83].

In the category *development*, 4 studies are published about *tools*. Weber [64] published the *tool* to visualize the nonvisual presentation and the non visual interaction. Nieters et al. [92] created standards-conformant GUI component libraries and tools to make it faster and easier to create a standard conformant application than to build an application that is not conformant. Humayoun et al. [3] published the two automated tools—UEMan and TaMUlator, to provide the realization of the development-environment which integrated UCD into software development processes.

In the category *testing*, Canfora et al. [85] published the benchmark tools like Quadrant, AnTuTu and Smartbench specific to Android applications. Also, the Microsoft Office and excel are used as *tools*. In the category *experience papers*, the majority of the studies are in the form of case study and literature reviews.

Goncalves and Santos [61], published about the *tool* called "POLVO", benefits to software developers such as increased agility in the development of user interface prototypes, ease of usability testing application with interactive prototypes, carrying out participatory design sessions, and documentation of prototypes. However, Goncalves and Santos suggested that the tool needs to be evolved, adding other nonfunctional requirements such as enhanced security, performance, reliability and availability [61]. According to Marianna et al. [56], many toolkits exist for doing traditional usability evaluations. However, UX evaluation differs from usability evaluation dramatically [56]. According to Hassenzahl and Tractinsky [1], tools do not capture the variety and emerging aspects of technology use, practitioners and researchers alike, seem to readily embrace the notion of UX as a viable alternative to traditional HCI.

Li et al. [57], published about the *tool* called 'UX office', to address the observations and provides support for UX professionals. Li et al. [57], discussed about the background information and how the UX Office deals with observations, is cost efficient, and makes the professional life of UX experts easier as well as enriches the resulting quality of outcomes, and allows collaboration between clients and service providers [57]. Zheng et al. [79], published the studies about the adoption of Rich Application Technologies (RATs), such as Windows Presentation Foundation (WPF) or Adobe Flex, which also enriches the user interface (UI) technology, and can boost collaborations among UX specialists, designers and developers by using the integrator as a new role in the existing RATs. The majority of the studies about *tools* focus on the *requirement*, *development*, and *testing* phases of the software development process. According to Nielsen & Norman [6], the first requirement for an exemplary UX is to meet the exact needs of the customer, without fuss or bother.

The result from the bubble chart indicates that the studies are mainly about the *requirement*, *development*, and *testing* phases, and the fewest number of studies are about *business planning* in the software development phases.

5.5 Distribution of UX studies in agile and Non-agile methodologies

The result from Figure 4.6 shows that the majority of the studies are about *non-agile* work practices. In the category *non-agile*, 31 studies are in the category of *lesson learned* and *framework/methods*. Non-agile software project sometimes over exceeds the project cost due to the unclear gathered requirement [52]. The main distinction between agile requirements engineering and traditional requirements engineering is that the former welcomes rapidly

changing requirements even late in the software development process and the later gathers and specifies requirements up front prior to software development [51]. The agile software development approach aims at overcoming the limitations of plan-driven approaches through considering changes to the system's requirements [40]. Agile methods focus on establishing close collaboration between customers and developers, and delivering software within time and budget constraints [40].

The studies about Just-In-Time (JIT) requirements analysis shows that agile software processes seek to follow an evolutionary approach to define requirements during the course of analysis [51]. The JIT design approach is quite difficult and not appropriate for creating UCD focused artifacts in agile environments [51]. The studies about the impact of UX in agile could improve UCD by providing more frequent iterations, which leads to more frequent usability evaluations and the early feedback can then be incorporated into the product more quickly [4]. However, one of the problems of integrating agile and UX design is the synchronization of their activities and practices during unit testing or acceptance testing of agile developers [4]. Another problem is that the collaboration between UX designers, agile developers, and other teams (such as marketing) needs to be enhanced through a large amount of communication [4].

Agile development methods are the most flexible approaches to software development where the development team keeps on improving the software with ongoing involvement of users [52]. Despite its flexibility, agile methods are not integrated with usability approaches which is crucial in order to achieve software usability [52]. Butt et al. [41] show that many software fails due to lack of user understanding and poor software interface [52]. However, the role of a usability expert is also not clear at any stage of software development process [52]. According to Ahmad et al. [52], usability does not focus on software projects, as the role of usability experts are not defined properly.

According to Kuusinen et al. [54], success of the product is achieved by adding a UX specialists in the scrum team, together with the developer and managers from the earlier stages of the development process [54]. Their study shows that companies should add a UX specialist in the team to coordinate with the users and the development team. However, small companies often do not follow a process model (such as scrum, kanban) [54]. Therefore, the small team needs to work together with the product owner and agree on their ways of working from the beginning of the project to improve UX [54].

Few of the studies in the category *non-agile* are about *advice and implications*, and *theory*. A study on agile methods and usability suggests that sharing design documents and artifacts, working with continuous interface improvement, integrating usability in daily development tasks, and avoiding having team members overspecialize in one area could address the issues between agile methods and usability [62].

The result from Figure 4.6 shows that, in the category *agile*, few of the studies are about *tool*. Humayoun et al. [3], published a framework that incorporates UCD into agile software development through a three-fold integration approach. The first approach at the process life-cycle level for the selection, the second approach at the iteration level for integrating UCD concepts, and the third approach at the development-environment level for managing and automating the sets of UCD activities through automated tools support [3].

The overall results from the study show that the majority of the studies are in the category *non-agile* about UX and the fewest number of studies are about *agile*.

5.6 Implications for research and practice

This study adds to the existing body of academic knowledge within software engineering through discussing the importance of UX in software engineering and providing an overview of how UX has been addressed in the existing literature about UX in software engineering and the existing gaps, which can guide future research. Also, this thesis raises the awareness of the studies about UX in software engineering, and highlights the need for further research and knowledge on the topic.

The results from this study can be used by practitioners to guide their efforts. For example, using UX tools in the earlier phases of the software development (*business planning*) is less expensive and avoids rework effort from practitioners. Further research to validate such efforts will be needed, as pointed out by Ogunyemi et al. [69]. Also, practitioners need to increase the work with UX in agile approaches and experiment with ways of integrating these approaches to avoid related barriers to software success.

6

Conclusion

This study set out to identify the frequency of publications, classifying the studies into different categories, to find out in what domains studies have been conducted, to analyze how UX tools are used in different software development phases, and to identify how UX studies are distributed between agile and non-agile about UX in software engineering through a systematic mapping study.

For RQ1 we conclude that the frequency of publications about UX has increased from 2007 and forward, which has likely to do with the increased attention towards mobile applications and UX theory. An interesting result is the fact that there is an increasing interest in user interaction studies within areas of software engineering.

For RQ2 the study shows that the majority of the studies (50%) are in the category *process management* and focus on *framework/methods* and only a few studies are published about *advice and implication*. 44% of the studies are in the category *managerial and organization* and focus on *evaluation research*, *experience papers* and *lesson learned*. We conclude that there is a lack of studies in the category *tools and technology* (6%).

For RQ3 we conclude that the majority of the studies are conceptual and therefore not related to any specific domain (65%). Only 35% of the studies are related to *specific domains* and in the categories *mobile, sales, online games, manufacturing, telecom, medical, insurance, automotive,* and *aviation*. Very few studies are related to the categories *medical, insurance, automotive* and *aviation*.

For RQ4 we conclude that UX tools are used in different software development phases and that the majority of the studies are about the later phases in the development cycle such as *development, testing* and *requirement* phases. Very few studies are about the earlier phases such as *business planning* phase. Also, none of the studies are about the categories *solution proposal*, and *opinion papers*.

For RQ5 we conclude that the majority of the studies (65%) are about *non-agile* approaches, and only 35% of studies are about *agile* approaches. Many of the studies are about *framework/methods* and *lesson learned* in both *agile* and *non-agile* focusing on UX, usability, HCI, User-Centered Design and *Human-Centered Design*. However, very few studies are about *theory* and *advice and implications*.

6.1 Future Work

In this study, the author investigated the state-of-art in literature about UX in software engineering, and the author identified that there are few studies published about UX *tools* related to software engineering. Future work and research is needed to further our understanding about the state of practice in companies and their needs. For example by conducting interviews from different roles, we can learn and understand how companies use *tools* in *business planning, requirement, development* and *testing phase* today, as well as understand what further tools they need and would like to use in these phases to further support their processes.

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A

Appendix

A.1: Initial set of Keywords Included/Excluded in the research:

S.no	Keywords	Include/Exclude in research	Reasons
1	User experience	Include	Our aim is to look for the research papers related to User experience
2	User-experience	Include	Some of the papers author referred user experience as 'user-experience'
3	UX	Include	Some of the papers author referred user experience as UX
4	Usability	Include	Author found lots of papers about the usability of user experience
5	Hedonic	Include	Author found lots of papers about the Hedonic and user experience
6	Emotion	Include	Author found lots of papers about the Emotion and user experience
7	Human centered	Include	Author found lots of papers about the Human centered and user experience
8	Human-centered	Include	Author found lots of papers about the Human-centered and user experience and/or software
9	User oriented	Include	Author found few papers about the User oriented and user experience and/or software.

10	**Human centred**	**Include**	**Author found lots of papers about the Human centered and user experience and/or software**
11	**User centered**	**Include**	**Author found lots of papers about the User centered and user experience and/or software**
12	**User-centered**	**Include**	**Author found lots of papers about the User-centered and user experience and/or software**
13	**User centred**	**Include**	**Author found lots of papers about the User centred and user experience and/or software**
14	**User-centred**	**Include**	**Author found lots of papers related to user-centred and user experience**
15	**Human-centred**	**Include**	**Author found lots of papers related to human-centred and user experience and/or software**
16	**User-oriented**	**Include**	**Author found it as an important keyword which relates to author subject**
17	**HMI**	**Include**	**Author found lots of papers related to HMI and user experience and/or software**
18	**UCD**	**Include**	**Author found lots of papers related to UCD and user experience and/or software**
19	**Interaction design**	**Include**	**Author found lots of papers related to Interaction design and user experience and/or software**
20	**Human computer interaction**	**Include**	**Author found lots of papers related to human computer interaction and user experience and/or software**
21	**Human-computer interaction**	**Include**	**Author found lots of papers related to human-computer interaction and user experience and/or software**
22	**HCI**	**Include**	**Author found lots of papers related to HCI and user experience and/or software**
23	**Satisfaction**	**Include**	**Author found lots of papers related to Satisfaction and user experience and/or software**
24	**Quality in use**	**Include**	**Author found lots of papers related to quality in use and user experience and/or software**

25	**Heuristic evaluation**	**Include**	**Author found some papers about heuristic evaluation and user experience and/or software**
26	**Prototype**	**Include**	**Author found it as an important keyword which relates to author main topic**
27	**Human-machine interaction**	**Include**	**Author found many papers which relate to author main topic**
28	**Software**	**Include**	**Our aim is to look for the research papers related to Software**
29	**IT**	**Include**	**Author found lots of papers related to IT and user experience**
30	**Information Technology**	**Include**	**Some of the paper author used Information Technology and user experience**
31	**IS**	**Include**	**No papers in IEEE and author found only one paper in Scopus but author referred as both Information System and IS.**
32	**Information System**	**Include**	**Author found lots of papers about the Information System and user experience**
33	**Human machine interaction**	**Include**	**Author found many papers which relate to author main topic**
34	**Emotional**	**Include**	**Author consider it as an important concept related to author main topic**
35	**User interface**	**Include**	**Author found some documents about user interface and user experience**
36	**User performance**	**Include**	**Author found some documents about user performance and user experience**
37	**User studies**	**Include**	**Found some documents about user studies in system development**
38	**System development**	**Include**	**Found some documents about user experiences in system development**
39	**IxD**	**Exclude**	**Not found any paper related to author research**
40	**Pleasure**	**Exclude**	**Not found any papers related to user experience (Some documents are available but already retrieved by using the keywords: user experience & software)**

41	**Pleasurable**	**Exclude**	**Not found any papers related to user experience (Some documents are available but already retrieved by using the keywords: user experience & software)**
42	**Appeal**	**Exclude**	**Not found any papers related to user experience**
43	**Desirability**	**Exclude**	**Not found any papers related to user experience (1 paper is available but already retrieved by using the keywords: user experience & software or Emotion)**
44	**Fun**	**Exclude**	**Not found any papers related to user experience (Some documents are available but already retrieved by using the keywords: user experience & software)**
45	**Joy**	**Exclude**	**Not found any papers related to user experience**
46	**Aesthetics**	**Exclude**	**Some documents are available but already retrieved by using the keywords: user experience & software**
47	**Storyboard**	**Exclude**	**Not found any papers related to user experience**
48	**Wireframe**	**Exclude**	**Not found any papers related to user experience**
49	**Mood**	**Exclude**	**not found any papers related to user experience**
50	**Usefulness**	**Exclude**	**Author have already use usability which is more related to author research**
51	**Non-task-related**	**Exclude**	**Author didn't find any papers about this subject**
52	**Feeling**	**Exclude**	**Author didn't find enough papers about this subject**
53	**Non-instrumental**	**Exclude**	**This keyword is not related to author subject and author didn't find enough papers about this subject**
54	**Human oriented**	**Exclude**	**Author didn't find enough papers about this subject**
55	**Human-oriented**	**Exclude**	**Author didn't find enough papers about this subject**

56	**HCD**	**Exclude**	**Author didn't find enough papers about this subject**
57	**Affective**	**Exclude**	**Author didn't find any paper related to user experience and software in scopus and engineering village**
58	**QIU**	**Exclude**	**Not found any papers**

A.2: Number of papers during first conduct search keywords using Engineering Village

S.no	Keywords	Number of Papers
1.	**"user experience"OR"user-experience"OR UX OR usability OR "user centered"OR"user-centered"OR "user centred" OR user-centred OR Hedonic OR emotion OR "human centered" OR"human-centered"OR"user oriented"OR"human centred"OR"human-centred"OR"user-oriented"OR"interaction design"OR "human computer interaction"OR human-computer interaction OR satisfaction OR " heuristic evaluation" OR"human-machine interaction"OR "human machine interaction" OR emotional OR "user studies"OR "user study" OR pleasure OR pleasurable OR appeal OR fun OR joy OR Aesthetics OR storyboard OR Mood OR feeling OR "Human oriented" OR Human-Oriented**	**152937**
2.	**"user experience"OR"user-experience"OR UX OR usability OR "user centered"OR"user-centered"OR "user centred" OR user-centred OR Hedonic OR emotion OR "human centered" OR"human-centered"OR"user oriented"OR"human centred"OR"human-centred"OR"user-oriented"OR"interaction design"OR "human computer interaction"OR human-computer interaction OR satisfaction OR " heuristic evaluation" OR"human-machine interaction"OR "human machine interaction" OR emotional OR "user studies"OR "user study" OR pleasure OR pleasurable OR appeal OR fun OR joy OR Aesthetics OR storyboard OR Mood OR feeling OR "Human oriented" OR Human-Oriented AND software**	**20487**
3.	**"user experience"OR"user-experience"OR UX OR usability OR "user centered"OR"user-centered"OR "user centred" OR user-centred OR Hedonic OR emotion OR "human centered" OR"human-centered"OR"user oriented"OR"human centred"OR"human-centred"OR"user-oriented"OR"interaction design"OR "human computer interaction"OR human-computer interaction OR satisfaction OR " heuristic evaluation" OR"human-machine interaction"OR "human machine interaction" OR emotional OR "user studies"OR "user study" OR pleasure OR pleasurable OR appeal OR fun OR joy OR Aesthetics OR storyboard OR Mood OR feeling OR "Human oriented" OR Human-Oriented AND (software OR "Information Technology")**	**22395**

4.	**"user experience"OR"user-experience"OR UX OR usability OR "user centered"OR"user-centered"OR "user centred" OR user-centred OR Hedonic OR emotion OR "human centered" OR"human-centered"OR"user oriented"OR"human centred"OR"human-centred"OR"user-oriented"OR"interaction design"OR "human computer interaction"OR human-computer interaction OR satisfaction OR " heuristic evaluation" OR"human-machine interaction"OR "human machine interaction" OR emotional OR "user studies"OR "user study" OR pleasure OR pleasurable OR appeal OR fun OR joy OR Aesthetics OR storyboard OR Mood OR feeling OR "Human oriented" OR Human-Oriented AND (software OR "Information System")**	**22027**
5.	**"user experience"OR"user-experience"OR UX OR usability OR "user centered"OR"user-centered"OR "user centred" OR user-centred OR Hedonic OR emotion OR "human centered" OR"human-centered"OR"user oriented"OR"human centred"OR"human-centred"OR"user-oriented"OR"interaction design"OR "human computer interaction"OR human-computer interaction OR satisfaction OR " heuristic evaluation" OR"human-machine interaction"OR "human machine interaction" OR emotional OR "user studies"OR "user study" OR pleasure OR pleasurable OR appeal OR fun OR joy OR Aesthetics OR storyboard OR Mood OR feeling OR "Human oriented" OR Human-Oriented AND (software OR "System Development")**	**20964**
6.	**"user experience"OR"user-experience"OR UX OR usability OR "user centered"OR"user-centered"OR "user centred" OR user-centred OR Hedonic OR emotion OR "human centered" OR"human-centered"OR"user oriented"OR"human centred"OR"human-centred"OR"user-oriented"OR"interaction design"OR "human computer interaction"OR human-computer interaction OR satisfaction OR " heuristic evaluation" OR"human-machine interaction"OR "human machine interaction" OR emotional OR "user studies"OR "user study" OR pleasure OR pleasurable OR appeal OR fun OR joy OR Aesthetics OR storyboard OR Mood OR feeling OR "Human oriented" OR Human-Oriented AND (software OR "Information Technology" OR "Information System" OR "System Development")**	**24221**
7.	**"user experience"OR"user-experience"OR UX OR usability OR "user centered"OR"user-centered"OR "user centred" OR user-centred OR Hedonic OR emotion OR "human centered" OR"human-centered"OR"user oriented"OR"human centred"OR"human-centred"OR"user-oriented"OR"interaction design"OR "human computer interaction"OR human-computer interaction OR satisfaction OR " heuristic evaluation" OR"human-machine interaction"OR "human machine interaction" OR emotional OR "user studies"OR "user study" OR pleasure OR pleasurable OR appeal OR fun OR joy OR Aesthetics OR storyboard OR Mood OR feeling OR "Human oriented" OR Human-Oriented AND "Requirement Engineering"**	**58**

8.	**"user experience"OR"user-experience"OR UX OR usability OR "user centered"OR"user-centered"OR "user centred" OR user-centred OR Hedonic OR emotion OR "human centered" OR"human-centered"OR"user oriented"OR"human centred"OR"human-centred"OR"user-oriented"OR"interaction design"OR "human computer interaction"OR human-computer interaction OR satisfaction OR " heuristic evaluation" OR"human-machine interaction"OR "human machine interaction" OR emotional OR "user studies"OR "user study" OR pleasure OR pleasurable OR appeal OR fun OR joy OR Aesthetics OR storyboard OR Mood OR feeling OR "Human oriented" OR Human-Oriented AND (software OR "Information Technology" OR "Information System" OR "System Development" OR "Requirement Engineering")**	**24233**

A.3: Fleiss's Kappa Value between two authors:

Crosstabs

Notes		
Output Created		**04-MAR-2015 11:21:54**
Comments		
Input	**Data**	**C:\Users\pragati\Desktop\New Kappa value.sav**
	Active Dataset	**DataSet1**
	Filter	**<none>**
	Weight	**<none>**
	Split File	**<none>**
	N of Rows in Working Data File	**53**
Missing Value Handling	**Definition of Missing**	**User-defined missing values are treated as missing.**
	Cases Used	**Statistics for each table are based on all the cases with valid data in the specified range(s) for all variables in each table.**

Syntax		**CROSSTABS /TABLES=Radha BY Ghazal /FORMAT=AVALUE TABLES /STATISTICS=KAPPA /CELLS=COUNT ROW COLUMN /COUNT ROUND CELL.**
Resources	**Processor Time**	**00:00:00.02**
	Elapsed Time	**00:00:00.03**
	Dimensions Requested	**2**
	Cells Available	**131029**

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Radha * Ghazal	**53**	**100.0%**	**0**	**0.0%**	**53**	**100.0%**

Radha * Ghazal Crosstabulation

			Ghazal			Total
				0	1	
fRadha		**Count**	**3**	**0**	**0**	**3**
		% within Radha	**100.0%**	**0.0%**	**0.0%**	**100.0%**
		% within Ghazal	**100.0%**	**0.0%**	**0.0%**	**5.7%**

	0	**Count**	**0**	**12**	**5**	**17**
		% within Radha	**0.0%**	**70.6%**	**29.4%**	**100.0%**
		% within Ghazal	**0.0%**	**92.3%**	**13.5%**	**32.1%**
	1	**Count**	**0**	**1**	**32**	**33**
		% within Radha	**0.0%**	**3.0%**	**97.0%**	**100.0%**
		% within Ghazal	**0.0%**	**7.7%**	**86.5%**	**62.3%**
Total		**Count**	**3**	**13**	**37**	**53**
		% within Radha	**5.7%**	**24.5%**	**69.8%**	**100.0%**
		% within Ghazal	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Symmetric Measures

		Value	**Asymp. Std. Error[a]**	**Approx. T[b]**	**Approx. Sig.**
Measure of Agreement	**Kappa**	**.766**	**.090**	**6.648**	**.000**
N of Valid Cases		**53**			

A.4 Complete details of Classification Schema

S.no	Publication Year	1st Author (year)	Title	Publication Fora	Publication Type	Research Methodology	Domain	Research Type	Contribution	Focus	UX Strategy
1	2014	Ogunyemi (2014)	Interplay between human-computer interaction and software engineering	Conference on Information Systems and Technologies (CISTI)	Conference	Literature Review	No Specific Domain	Evaluation research	Framework/methods	Process management	Human-computer interaction (HCI)
2	2014	Law (2014)	Interplay between User Experience (UX) evaluation and system development	International Journal of Human-Computer Studies	Journal	Literature Review, Questionnaires	No Specific Domain	Experience papers	Lesson learned	Managerial/ organizational	User Experience
3	2001	Vasmatzidis (2001)	Introducing usability engineering into the cmm model: An empirical approach	Proceedings of the Human Factors and Ergonomics Society Annual Meeting	Journal		No Specific Domain	Experience papers	Framework/methods	Managerial/ organizational	Usability
4	2009	Hussain (2009)	Investigating Agile User-Centered Design in Practice: A Grounded Theory Perspective	HCI and Usability for e-Inclusion	Book Chapter	Qualitative Approach	No Specific Domain	Evaluation research	Model	Process management	User-centered design (UCD)
5	2014	Ardito (2014)	Investigating and promoting UX practice in industry: An experimental study	International Journal of Human-Computer Studies	Journal	Experiment	No Specific Domain	Evaluation research	Guidelines	Process management	User Experience
6	2009	Heiskari (2009)	Investigating the State of User Involvement in Practice	Asia-Pacific Software Engineering Conference (APSEC)	Conference	Case Study	No Specific Domain	Solution proposal	Lesson learned	Managerial/ organizational	User involvement
7	2007	Begior (2007)	Involving users to improve the level of their satisfaction from a software product designed for public organization	Technologies for Business Information Systems	Book Chapter		No Specific Domain	Experience papers	Framework/methods	Process management	User involvement
8	2008	M Hellman (2008)	Is User Experience supported effectively in existing software development processes?	Valid Useful User Experience Measurement (VUUM)	Conference		Mobile Industry	Philosophical papers	Guidelines	Managerial/ organizational	User experience
9	2003	Gulliksen (2003)	Key principles for user-centred systems design	Behaviour & Information Technology	Journal	Action Research	No Specific Domain	Evaluation research	Tool	Managerial/ Organizational	User-centred design

10	**2011**	**Nebe (2011)**	**Key requirements for integrating usability engineering and software engineering**	**Human-Computer Interaction International Conference (HCI)**	**Conference**	**Questionnaires**	**No Specific Domain**	**Philosophical papers**	**Framework/methods**	**Managerial/ Organizational**	**Usability**
11	**2010**	**Law (2010)**	**Interplay between User Experience Evaluation and Software Development: Challenge and Outlook**	**Nordic Conference on Human-Computer Interaction (NordiCHI)**	**Conference**		**No Specific Domain**	**Experience papers**	**Lesson learned**	**Process management**	**User Experience**
12	**2014**	**Liikkanen (2014)**	**Lean UX - The next generation of user-centered Agile development?**	**Nordic Conference on Human-Computer Interaction (NordiCHI)**	**Conference**	**Experiment**	**No Specific Domain**	**Solution proposal**	**Framework/methods**	**Process management**	**User Experience**
13	**2013**	**Solanki (2013)**	**Lessons learned during a HCI design process in intercultural context**	**Christian Community Development (CCD)**	**Conference**	**Case Study**	**Sales Domain**	**Experience papers**	**Lesson learned**	**Process management**	**Human-computer interaction (HCI)**
14	**2009**	**Adikari (2009)**	**Little design up-front: A design science approach to integrating usability into agile requirements engineering**	**Human-Computer Interaction International Conference (HCI)**	**Conference**	**Design Research**	**No Specific Domain**	**Evaluation research**	**Framework/methods**	**Process management**	**User-centered design (UCD)**
15	**2007**	**Viorres (2007)**	**Major HCI challenges for open source software adoption and development**	**The Orange County Swim Conference (OCSC)**	**Conference**		**Sales Domain**	**Solution proposal**	**Framework/methods**	**Process management**	**Human-computer interaction (HCI)**
16	**2007**	**Detweiler (2007)**	**Managing UCD within agile projects**	**Interactions**	**Journal**		**No Specific Domain**	**Experience papers**	**Lesson learned**	**Managerial/ Organizational**	**User-centered design (UCD)**
17	**2010**	**Wolkerstorfer (2010)**	**Matching HCI methods and developers values in extreme programming development processes**	**Nordic Conference on Human-Computer Interaction (NordiCHI)**	**Conference**		**No Specific Domain**	**Experience papers**	**Advice/Implications**	**Managerial/ Organizational**	**Human-computer interaction (HCI)**
18	**2012**	**Rauschenberger (2012)**	**Measurement of user experience: A Spanish language version of the user experience questionnaire (UEQ)**	**Conference on Information Systems and Technologies (CISTI)**	**Conference**	**Questionnaires**	**No Specific Domain**	**Experience papers**	**Tool**	**Process management**	**User Experience**
19	**2010**	**Joshi (2010)**	**Measuring effectiveness of HCI integration in software development processes**	**Journal of Systems and Software**	**Journal**	**Qualitative**	**Online games**	**Evaluation research**	**Framework/methods**	**Process management**	**Human-computer interaction (HCI)**
20	**2006**	**Lai (2006)**	**Measuring usability: Use HMM emotion method and parameter optimize**	**International Conference on Computing, Networking and Communication (ICNC)**	**Conference**		**No Specific Domain**	**Experience papers**	**Lesson learned**	**Process management**	**Usability**

21	**2009**	**Winter (2009)**	**Measuring usability-balancing agility and formality: for stakeholders' needs in software development**	**Measuring Usability - Balancing Agility and Formality**	**Book Chapter**	**Case Study**	**Manufacturing domain**	**Evaluation research**	**Model**	**Process management**	**Usability**
22	**2001**	**Maguire (2001)**	**Methods to support human-centred design**	**International Journal of Human-Computer Studies**	**Journal**		**Manufacturing domain**	**Evaluation research**	**Lesson learned**	**Process management**	**Human-centred design**
23	**2002**	**Ruthford (2002)**	**Mix and match usability methods: picking the pieces for our project**	**The Intergovernmental Panel on Climate Change (IPCC)**	**Conference**		**No Specific Domain**	**Evaluation research**	**Model**	**Process management**	**Usability**
24	**2013**	**Abdulhak (2013)**	**Modified intensive prototype model for better user experience and usability improvements in software and web application design and development**	**Ubiquitous Information Technologies and Applications**	**Book Chapter**	**Experiment**	**No Specific Domain**	**Experience papers**	**Lesson learned**	**Managerial/ Organizational**	**User Experience**
25	**2007**	**Anderson (2007)**	**Moving ux into a position of corporate influence: Whose advice really works?**	**Extended Abstracts on Human Factors in Computing Systems (CHI EA)**	**Conference**		**No Specific Domain**	**Experience papers**	**Advice/Implications**	**Managerial/ Organizational**	**User Experience**
26	**2008**	**Haesen (2008)**	**MuiCSer: A Multi-disciplinary User-Centered Software Engineering Process to increase the overal User Experience**	**International Journal of Human-Computer Studies**	**Journal**		**No Specific Domain**	**Evaluation Research**	**Framework/methods**	**Managerial/ Organizational**	**User-centered design (UCD)**
27	**2008**	**Haesen (2008)**	**MuiCSer: A process framework for multi-disciplinary user-centred software engineering processes**	**International Conference on Human-Centered Software Engineering (HCSE)**	**Conference**	**Case Study**	**No Specific Domain**	**Philosophical papers**	**Framework/methods**	**Managerial/ Organizational**	**User-centred design**
28	**2007**	**Paay (2007)**	**A Gestalt theoretic perspective on the user experience of location-based services**	**Human-Computer Interaction International Conference (HCI)**	**Conference**	**Mobile Industry**	**Experience papers**	**Theory**	**Tools and technology**	**User Experience**	**Mobile Industry**
29	**2013**	**Bobkowska (2013)**	**On explaining intuitiveness of software engineering techniques with user experience concepts**	**Multimedia, Interaction, Design and Innovation Conference (MIDI)**	**Conference**	**Qualitative**	**No Specific Domain**	**Evaluation research**	**Framework/methods**	**Process management**	**User Experience**

30	2014	Larusdottir (2014)	On the integration of user centred design in agile development	Nordic Conference on Human-Computer Interaction (NordiCHI)	Conference		No Specific Domain	Opinion papers	Guidelines	Managerial/ Organizational	User-centred design
31	2007	Friedland (2007)	Onshore-offshore: Product development that won't break your designs	Interactions	Journal		No Specific Domain	Experience papers	Lesson learned	Managerial/ Organizational	User Experience
32	2013	Rajanen (2013)	Open source and human computer interaction philosophies in open source projects - Incompatible or Co-existent?	Human-Computer Interaction International Conference (HCI)	Conference	Case Study	Online games	Evaluation research	Framework/methods	Managerial/ Organizational	Human-computer interaction (HCI)
33	2005	Friedland (2005)	Outsourcing & offshoring: Impact on the user experience	Extended Abstracts on Human Factors in Computing Systems (CHI EA)	Conference		No Specific Domain	Opinion papers	Lesson learned	Managerial/ Organizational	User Experience
34	2010	Terry (2010)	Perceptions and practices of usability in the free/open source software (FoSS) community	Special Interest Group on Computer-Human Interaction (SIGCHI)	Conference		Online games	Evaluation research	Model	Process management	Usability
35	2014	Caballero (2014)	Persona as a Tool to Involving Human in Agile Methods: Contributions from HCI and Marketing	International Conference on Human-Centered Software Engineering (HCSE)	Conference		Sales Domain	Experience papers	Tool	Process management	Human-computer interaction (HCI)
36	2011	Gon (2011)	POLVO - Software for prototyping of low-fidelity interfaces in agile development	Human-Computer Interaction International Conference (HCI)	Conference		Sales Domain	Evaluation research	Framework/methods	Process management	Human-computer interaction (HCI)
37	2012	Hussain (2012)	Practical Usability in XP Software Development Processes	Advances in Computer-Human Interactions (ACHI)	Conference	Case Study	Sales Domain	Experience papers	Lesson learned	Process management	Usability
38	2001	Potsus (2001)	Pradeep Henry User-centered information design for improved software usability Book Review	Professional Communication, IEEE Transactions	Journal		No Specific Domain	Opinion papers	Guidelines	Managerial/ Organizational	User-centered design (UCD)
39	2014	de Oliveira (2014)	Predictive usability evaluation: aligning HCI and software engineering practices	Interaction Homme-Machine (IHM)	Conference		No Specific Domain	Evaluation research	Guidelines	Managerial/ Organizational	Human-computer interaction (HCI)

40	**2014**	**Popli (2014)**	**Prioritising user stories in agile environment**	**International Conference on Information and Computer Technology (ICICT)**	**Conference**		**No Specific Domain**	**Evaluation research**	**Lesson learned**	**Process management**	**Usability**
41	**2014**	**Tanikawa (2014)**	**Problems in usability improvement activity by software engineers: Consideration through verification experiments for human-centered design process support environment**	**Human-Computer Interaction International Conference (HCI)**	**Conference**		**No Specific Domain**	**Evaluation research**	**Model**	**Managerial/ Organizational**	**Human-centered design (HCD)**
42	**2002**	**Constantine (2002)**	**Process agility and software usability: Toward lightweight usage-centered design**	**Agile Usability**	**Journal**		**Online games**	**Evaluation research**	**Framework/methods**	**Process management**	**Usage-centered design**
43	**2001**	**Players (2001)**	**Process Agility and Software Usability: Toward Lightweight Usage-Centered Design**	**Agile Usability**	**Journal**		**Online games**	**Evaluation research**	**Framework/methods**	**Process management**	**Usage-centered design**
44	**2014**	**Tanikawa (2014)**	**Process support method for improved user experience**	**NEC Technical Journal**	**Journal**		**No Specific Domain**	**Evaluation research**	**Guidelines**	**Process management**	**User Experience m,**
45	**1998**	**Weber (1998)**	**Programming for usability in nonvisual user interfaces**	**ASSETS**	**Conference**		**No Specific Domain**	**Evaluation research**	**Tool**	**Tools and Technology**	**Usability**
46	**2013**	**Kanako (2013)**	**Proposal for Objective Evaluation of User Experiences**	**International Conference on Biometrics and Kansei Engineering (ICBAKE)**	**Conference**	**Experiment**	**No Specific Domain**	**Experience papers**	**Lesson learned**	**Managerial/ Organizational**	**User Experience**
47	**2013**	**Miki (2013)**	**Reconsidering the notion of user experience for human-centered design**	**Human-Computer Interaction International Conference (HCI)**	**Conference**		**No Specific Domain**	**Philosophical papers**	**Framework/methods**	**Managerial/ Organizational**	**User Experience**
48	**2013**	**Adikari (2013)**	**Reframed contexts: Design thinking for agile user experience design**	**International Conference on Design, User Experience and Usability (DUXU)**	**Conference**		**No Specific Domain**	**Philosophical papers**	**Framework/methods**	**Process management**	**User Experience**

49	**2008**	**Ronkko (2008)**	**Reporting user experience through usability within the telecommunications industry**	**The Charities and Associations Event (CHASE)**	**Conference**		**Telecom Domain**	**Experience papers**	**Lesson learned**	**Process management**	**User Experience**
50	**2008**	**Obendorf (2008)**	**Scenario-based usability engineering techniques in agile development processes**	**Extended Abstracts on Human Factors in Computing Systems (CHI EA)**	**Conference**		**Insurance Domain**	**Experience papers**	**Tool**	**Process management**	**Usability**
51	**2003**	**Clemmensen (2003)**	**Separation in theory, coordination in practice - teaching HCI and SE**	**Software Process: Improvement and Practice**	**Journal**		**No Specific Domain**	**Experience papers**	**Lesson learned**	**Process management**	**Human-computer interaction (HCI)**
52	**2004**	**Henke (2004)**	**Shaping a positive user experience by cross-skill teaming**	**The Intergovernmental Panel on Climate Change (IPCC)**	**Conference**		**No Specific Domain**	**Experience papers**	**Lesson learned**	**Managerial/ Organizational**	**User Experience**
53	**2010**	**Kumar (2010)**	**Sig: Branding the changing enterprise - Impact of mergers & acquisitions on user experience organizations**	**Extended Abstracts on Human Factors in Computing Systems (CHI EA)**	**Conference**		**Insurance Domain**	**Experience papers**	**Lesson learned**	**Managerial/ Organizational**	**User Experience**
54	**2013**	**Barksdale (2013)**	**Social Integration in Agile User Experience: Building Social Capital in Agile User Experience Software Teams**	**Journal of Software Engineering**	**Journal**		**No Specific Domain**	**Evaluation research**	**Framework/methods**	**Process management**	**User Experience**
55	**2007**	**Parsons (2007)**	**Software development methodologies, agile development and usability engineering**	**The Association for Contemporary Iberian Studies (ACIS)**	**Conference**		**Sales Domain**	**Evaluation research**	**Framework/methods**	**Process management**	**Usability**
56	**1996**	**McCain (1996)**	**Software Usability as a Foundation for Human-Computer Interaction Design**	**Human Interaction with Complex Systems**	**Book Chapter**		**No Specific Domain**	**Evaluation research**	**Framework/methods**	**Managerial/ Organizational**	**Human-computer interaction (HCI)**
57	**2011**	**Zheng (2011)**	**Streamlining user experience design and development: Roles, tasks and workflow of applying rich application technologies**	**Human-Computer Interaction International Conference (HCI)**	**Conference**		**No Specific Domain**	**Experience papers**	**Tool**	**Managerial/ Organizational**	**User Experience**
58	**2005**	**Ashley (2005)**	**Success with user-centered design management**	**Interactions**	**Journal**		**No Specific Domain**	**Evaluation research**	**Guidelines**	**Managerial/ Organizational**	**User-centered design (UCD)**

59	**1999**	**Hakiel (1999)**	**Sufficient and necessary conditions for routine deployment of user-centred design**	**The Institute for Excellence in Education (IEE)**	**Conference**		**No Specific Domain**	**Evaluation research**	**Guidelines**	**Managerial/ Organizational**	**User-centered design (UCD)**
60	**2014**	**Ralph (2014)**	**Supporting the uninitiated in user-centered design**	**Interactions**	**Journal**		**Sales Domain**	**Experience papers**	**Lesson learned**	**Managerial/ Organizational**	**User-centered design (UCD)**
61	**2008**	**Ambler (2008)**	**Tailoring usability into agile software development projects**	**Maturing Usability**	**Book Chapter**		**Online games**	**Philosophical papers**	**Framework/methods**	**Process management**	**Usability**
62	**2012**	**Lŕusd (2012)**	**The big picture of UX is missing in scrum projects**	**Nordic Conference on Human-Computer Interaction (NordiCHI)**	**Conference**	**Interview**	**No Specific Domain**	**Experience papers**	**Framework/methods**	**Process management**	**User Experience**
63	**2010**	**Nass (2010)**	**The fulfillment of user needs and the course of time in field investigation**	**Extended Abstracts on Human Factors in Computing Systems (CHI EA)**	**Conference**		**Online games**	**Evaluation research**	**Model**	**Process management**	**User Experience**
64	**2001**	**van der (2001)**	**The human-computer interface is the system; a plea for a poor man's HCI component in software engineering curricula**	**Human-Computer Interaction International Conference (HCI)**	**Conference**		**No Specific Domain**	**Evaluation research**	**Framework/methods**	**Process management**	**Human-computer interaction (HCI)**
65	**2006**	**Gorlenko (2006)**	**The moment of truth: How much does culture matter to you?**	**Interactions**	**Conference**		**No Specific Domain**	**Evaluation research**	**Model**	**Managerial/ Organizational**	**User Experience**
66	**2004**	**Seffah (2004)**	**The obstacles and myths of usability and software engineering**	**Journal of Software Engineering**	**Journal**		**Mobile Industry**	**Experience papers**	**Framework/methods**	**Process management**	**Usability**
67	**2010**	**Fø lstad (2010)**	**The relevance of UX models and measures**	**Nordic Conference on Human-Computer Interaction (NordiCHI)**	**Conference**		**No Specific Domain**	**Experience papers**	**Framework/methods**	**Process management**	**User Experience**
68	**2006**	**Lievesley (2006)**	**The role of the interaction designer in an agile software development process**	**Extended Abstracts on Human Factors in Computing Systems (CHI EA)**	**Conference**	**Case Study**	**Sales Domain**	**Experience papers**	**Guidelines**	**Managerial/ Organizational**	**User interface**
69	**2014**	**Alves (2014)**	**The state of user experience evaluation practice**	**Nordic Conference on Human-Computer Interaction (NordiCHI)**	**Conference**		**Mobile Industry**	**Opinion papers**	**Model**	**Process management**	**User Experience**

70	**2003**	**Goransson (2003)**	**The usability design process - integrating user-centered systems design in the software development process**	**Software Process: Improvement and Practice**	**Journal**		**No Specific Domain**	**Philosophical papers**	**Framework/methods**	**Process management**	**Human-computer interaction (HCI)**
71	**2002**	**Gruen (2002)**	**The Use of Stories in User Experience Design**	**Nordic Conference on Human-Computer Interaction (NordiCHI)**	**Conference**		**Sales Domain**	**Solution proposal**	**Model**	**Managerial/ Organizational**	**User Experience**
72	**2007**	**Nieters (2007)**	**Tools to increase the strategic value of user experience design**	**International Conference on Usability and Internationalization (UI-HCII)**	**Conference**	**Case Study**	**No Specific Domain**	**Philosophical papers**	**Tool**	**Tools and Technology**	**User Experience**
73	**2006**	**Chamberlain (2006)**	**Towards a framework for integrating agile development and user-centred design**	**AGILE**	**Conference**	**Questionnaires**	**No Specific Domain**	**Evaluation research**	**Lesson learned**	**Process management**	**User-centred design**
74	**2014**	**Butt (2014)**	**Towards a Model-Based Framework for Integrating Usability Evaluation Techniques in Agile Software Model**	**Society for Clinical Data Management (SCDM)**	**Conference**	**Literature Review**	**No Specific Domain**	**Philosophical papers**	**Framework/methods**	**Process management**	**Usability**
75	**2007**	**Lee (2007)**	**Towards Extreme(ly) Usable Software: Exploring Tensions Between Usability and Agile Software Development**	**AGILE**	**Conference**	**Case Study**	**No Specific Domain**	**Opinion papers**	**Guidelines**	**Process management**	**Usability**
76	**2008**	**Najafi (2008)**	**Two Case Studies of User Experience Design and Agile Development**	**AGILE**	**Conference**	**Case Study**	**Telecom Domain**	**Solution proposal**	**Model**	**Process management**	**User Experience**
77	**2010**	**Jokela (2010)**	**Two gaps instead of one. the interplay between user experience engineering and interaction design**	**Nordic Conference on Human-Computer Interaction (NordiCHI)**	**Conference**		**No Specific Domain**	**Experience papers**	**Lesson learned**	**Process management**	**User Experience**
78	**2003**	**Gulliksen (2003)**	**Usability Design: Integrating User Centered System Design in the Software Development Process.**	**INTERACT**	**Conference**		**No Specific Domain**	**Solution proposal**	**Advice/Implications**	**Process management**	**User-centred design**
79	**2013**	**Ahmad (2013)**	**Usability Evaluation of the Agile Software Process**	**International Visual Informatics Conference 2015 (IVIC)**	**Conference**	**Literature Review, Experiment**	**No Specific Domain**	**Evaluation Research**	**Framework/methods**	**Process management**	**Usability**

80	**2003**	**Constantine (2003)**	**Usage-centered software engineering: an agile approach to integrating users, user interfaces, and usability into software engineering practice**	**The International Conference on Software Engineering (ICSE)**	**Conference**		**No Specific Domain**	**Philosophical papers**	**Framework/methods**	**Process management**	**Usage-centered design**
81	**1996**	**Constantine (1996)**	**Usage-centered software engineering: new models, methods, and metrics**	**Software Engineering: Education and Practice**	**Conference**		**No Specific Domain**	**Philosophical papers**	**Framework/methods**	**Tools and Technology**	**Usage-centered design**
82	**2008**	**Singh (2008)**	**U-SCRUM: An Agile Methodology for Promoting Usability**	**International Conference on Usability and Internationalization (UI-HCII)**	**Conference**		**No Specific Domain**	**Solution proposal**	**Lesson learned**	**Process management**	**Usability**
83	**2014**	**Varsaluoma (2014)**	**Usefulness of long-term user experience evaluation to product development: Practitioners' views from three case studies**	**Nordic Conference on Human-Computer Interaction (NordiCHI)**	**Conference**	**Case Study**	**Manufacturing domain**	**Evaluation research**	**Framework/methods**	**Managerial/ Organizational**	**User Experience**
84	**2003**	**Granollers (2003)**	**User Centred Design Process Model. Integration of Usability Engineering and Software Engineering**	**INTERACT**	**Conference**		**No Specific Domain**	**Solution proposal**	**Framework/methods**	**Process management**	**User-centred design**
85	**2011**	**Ferreira (2011)**	**User experience design and agile development: managing cooperation through articulation work**	**Software: Practice and Experience**	**Journal**	**Observation**	**No Specific Domain**	**Evaluation research**	**Framework/methods**	**Process management**	**User Experience**
86	**2012**	**Isomursu (2012)**	**User Experience Design Goes Agile in Lean Transformation – A Case Study**	**AGILE**	**Conference**	**Case Study**	**Telecom Domain**	**Philosophical papers**	**Lesson learned**	**Managerial/ Organizational**	**User Experience**
87	**2008**	**Joshi (2008)**	**User experience metric and index of integration: Measuring impact of HCI activities on user experience**	**Human-Computer Interaction International Conference (HCI)**	**Conference**		**Telecom Domain**	**Experience papers**	**Framework/methods**	**Process management**	**User Experience**
88	**2011**	**Masip (2011)**	**User experience specification through quality attributes**	**International Federation for Information Processing Technical Committee (IFIP TC)**	**Conference**		**No Specific Domain**	**Solution proposal**	**Advice/implications**	**Managerial/ organizational**	**User Experience**

89	**2011**	**Da silva (2011)**	**User-Centered Design and Agile Methods: A Systematic Review**	**AGILE**	**Conference**	**Systematic literature review**	**No Specific Domain**	**Evaluation research**	**Lesson learned**	**Managerial/ organizational**	**User-centered design (UCD)**
90	**2014**	**Kropp (2014)**	**User-centered-design in agile RE through an On-site User Experience Consultant**	**International Workshop on Usability and Accessibility Focused Requirements Engineering (UsARE)**	**Conference**		**No Specific Domain**	**Experience papers**	**Lesson learned**	**Process management**	**User-centered design (UCD)**
91	**2011**	**Al-Badareen (2011)**	**Users' perspective of software quality**	**World Scientific and Engineering Academy and Society (WSEAS)**	**Conference**		**No Specific Domain**	**Philosophical papers**	**Model**	**Process management**	**User perspective**
92	**2003**	**Scholtz (2003)**	**Using consumer demands to bridge the gap between software engineering and usability engineering**	**Software Process: Improvement and Practice**	**Journal**	**Case study**	**Aviation**	**Solution proposal**	**Framework/method**	**Tools and technology**	**Usability**
93	**2007**	**Ma (2007)**	**UX Office. A New Software Application for User Experience Services**	**Human-Computer Interaction International Conference (HCI)**	**Conference**		**No Specific Domain**	**Experience papers**	**Tool**	**Tools and technology**	**User Experience**
94	**2010**	**Ferreira (2010)**	**Values and assumptions shaping Agile development and User Experience design in practice**	**AGILE**	**Conference**	**Case study**	**No Specific Domain**	**Philosophical papers**	**Lesson learned**	**Managerial/ organizational**	**User Experience**
95	**2014**	**Brauer (2014)**	**What web analysts can do for human-computer interaction?**	**International Conference on Human-Computer Interaction in Business (HCIB)**	**Conference**		**No Specific Domain**	**Evaluation research**	**Lesson learned**	**Managerial/ organizational**	**Human-computer interaction (HCI)**
96	**2009**	**Budwig (2009)**	**When user experience met agile: A case study**	**Extended Abstracts on Human Factors in Computing Systems (CHI EA)**	**Conference**	**Case study**	**No Specific Domain**	**Experience papers**	**Lesson learned**	**Managerial/ organizational**	**User Experience**
97	**2013**	**Bias (2013)**	**Where's the Rigor in the Field of Usability Analysis?**	**International Journal of Human-Computer Studies**	**Journal**		**No Specific Domain**	**Opinion papers**	**Lesson learned**	**Managerial/ organizational**	**Usability**
98	**2009**	**Treviranus (2009)**	**You say tomato, I say tomato, let's not call the whole thing off: the challenge of user experience design in distributed learning environments**	**Journal of Computer Science and Technology**	**Journal**		**No Specific Domain**	**Solution proposal**	**Lesson learned**	**Process management**	**User Experience**

99	**2013**	**Canfora (2013)**	**A Case Study of Automating User Experience-Oriented Performance Testing on Smartphones**	**International Conference on Software Testing, Verification and Validation (ICST)**	**Conference**		**Mobile Industry**	**Experience papers**	**Tool**	**Tools and technology**	**User Experience**
100	**2008**	**Egh (2008)**	**A case study of three software projects: can software developers anticipate the usability problems in their software?**	**Behaviour & Information Technology**	**Journal**	**Case study**	**Medical Domain**	**Evaluation research**	**Lesson learned**	**Managerial/ organizational**	**Usability**
101	**2010**	**Vukelja (2010)**	**A Case Study of User-Centred Design in Four Swiss RUP Projects**	**Advances in Human-Computer Interaction archive**	**Journal**	**Case study**	**Manufacturing domain**	**Evaluation research**	**Lesson learned**	**managerial/ organizational**	**User-centered design (UCD)**
102	**2012**	**Faulring (2012)**	**A case study of using HCI methods to improve tools for programmers**	**The Charities and Associations Event (CHASE)**	**Conference**	**Case study**	**Manufacturing domain**	**Evaluation research**	**Tool**	**process management**	**Human-computer interaction (HCI)**
103	**2008**	**Ploskonos (2008)**	**A classification schema for process and method adaptation in software design projects**	**DESIGN**	**Conference**	**Observation**	**Sales Domain**	**philosophical papers**	**lesson learned**	**managerial/ organizational**	**User-centered design (UCD)**
104	**2007**	**Winter (2007)**	**A comprehensive model of usability**	**Working Conference on Engineering for Human-Computer Interaction (EHCI)**	**Conference**	**Case study**	**No Specific Domain**	**Solution proposal**	**Model**	**Process management**	**Usability**
105	**2009**	**Peixoto (2009)**	**A Conceptual Knowledge Base Representation for Agile Design of Human-Computer Interface**	**The International Institute of Tropical Agriculture (IITA)**	**Conference**	**Case study**	**No Specific Domain**	**solution proposal**	**framework /method**	**Process management**	**Human-computer interaction (HCI)**
106	**2014**	**Martella (2014)**	**A dialogue-based framework for the user experience reengineering of a legacy application**	**Networking and Parallel/Distributed Computing (SNPD)**	**Conference**	**Case study**	**No Specific Domain**	**evaluation research**	**framework /method**	**Process management**	**User Experience**
107	**2013**	**Dino (2013)**	**A Framework for Integrating Software Usability into Software Development Process**	**Journal of Computer Science and Technology**	**Journal**	**Literature study**	**No Specific Domain**	**solution proposal**	**framework /method**	**Process management**	**Usability**
108	**2013**	**Tan (2013)**	**A Framework for Software Usability and User Experience Measurement in Mobile Industry**	**International Workshop on Software Measurement (IWSM-MENSURA)**	**Conference**	**Case study**	**Mobile Industry**	**solution proposal**	**framework /method**	**process management**	**Usability**

109	**2011**	**Schulze (2011)**	**A framework to measure User eXperience of interactive online products**	**Conference of Mennonite Brethren (MB)**	**Conference**	**Questionnaire**	**Telecom Domain**	**solution proposal**	**framework /method**	**process management**	**User Experience**
110	**2013**	**Lee (2013)**	**A study on the interaction between human and smart devices based on emotion recognition**	**Human-Computer Interaction International Conference (HCI)**	**Conference**	**Experiment**	**Mobile Industry**	**Evaluation research**	**Theory**	**Process management**	**Emotion**
111	**2007**	**Juristo (2007)**	**A glass box design: making the impact of usability on software development visible**	**International Federation for Information Processing Technical Committee (IFIP TC)**	**Conference**		**No Specific Domain**	**Philosophical papers**	**framework /method**	**Process management**	**Usability**
112	**1995**	**Badham (1995)**	**A human centred approach to simulation: a case study of software to support system design and development**	**Hawaii International Conference on System Sciences (HICSS)**	**Conference**	**Case study**	**Manufacturing domain**	**Experience papers**	**lesson learned**	**managerial/ organizational**	**Human-centered design (HCD)**
113	**2010**	**Xiong (2010)**	**A new combined method for UCD and software development and case study**	**International Conference on Information Systems Engineering (ICISE)**	**Conference**	**Case study**	**Mobile Industry**	**Experience papers**	**Model**	**Process management**	**User-centered design (UCD)**
114	**2013**	**Williams (2013)**	**A qualitative case study of LifeGuide: Users' experiences of software for developing Internet-based behaviour change interventions**	**Health Informatics Journal**	**Journal**	**Case study**	**Medical Domain**	**Evaluation research**	**Guidelines**	**Process management**	**User Experience**
115	**2008**	**Deryckere (2008)**	**A software tool to relate technical performance to user experience in a mobile context**	**International Symposium on a World of Wireless, Mobile and Multimedia Networks, (WoWMoM)**	**Conference**		**Mobile Industry**	**Experience papers**	**Frameworks/methods**	**Process management**	**User Experience**
116	**2014**	**Kuusinen (2014)**	**On Designing UX for Mobile Enterprise Apps**	**EUROMICRO**	**Conference**	**Interview**	**Mobile Industry**	**Evaluation research**	**Theory**	**Managerial/ Organizational**	**User Experience**
117	**2009**	**Peng (2009)**	**A Study on User Experience of Online Games**	**Western Conference on Science Education (WCSE)**	**Conference**	**Questionnaire**	**Online games**	**Evaluation research**	**Guidelines**	**Process management**	**User Experience**
118	**2002**	**Vredenburg (2002)**	**A survey of user-centered design practice**	**Special Interest Group on Computer-Human Interaction (SIGCHI)**	**Conference**	**Literature review & Questionnaire**	**No Specific Domain**	**Evaluation research**	**Lesson learned**	**Managerial/ organizational**	**User-centered design (UCD)**

119	**2011**	**Humayoun (2011)**	**A three-fold integration framework to incorporate user-centered design into agile software development**	**Human Centered Design (HCD)**	**Conference**	**Case study**	**Manufacturing domain**	**Philosophical paper**	**Tool**	**Process management**	**User-centered design (UCD)**
120	**2013**	**Meingast (2013)**	**Agile and UX: The road to integration- The challenges of the UX practitioner in an agile environment**	**Proceedings of the Human Factors and Ergonomics Society Annual Meeting**	**Journal**		**No Specific Domain**	**Opinion paper**	**Lesson learned**	**Managerial/ organizational**	**User Experience**
121	**2012**	**Ferreira (2012)**	**Agile Development and User Experience Design Integration as an Ongoing Achievement in Practice**	**AGILE**	**Conference**	**Observation**	**Mobile Industry**	**Experience paper**	**framework /method**	**Managerial/ organizational**	**User Experience**
122	**2012**	**Ferreira (2012)**	**Agile development and UX design: Towards understanding work cultures to support integration**	**International Conference on Advanced Information Systems (CAiSE)**	**Conference**		**No Specific Domain**	**Opinion papers**	**Advice/implications**	**Managerial/ organizational**	**User Experience**
123	**2007**	**Ferreira (2007)**	**Agile development iterations and UI design**	**AGILE**	**Conference**	**Interview**	**No Specific Domain**	**Experience papers**	**Lesson learned**	**Managerial/ organizational**	**User Experience**
124	**2007**	**Memmel (2007)**	**Agile human-centered software engineering**	**British Computer Society Conference on Human-Computer Interaction (BCS-HCI)**	**Conference**		**No Specific Domain**	**Philosophical papers**	**framework /method**	**Process management**	**Human-centered design (HCD)**
125	**2008**	**Fox (2008)**	**Agile Methods and User-Centered Design: How These Two Methodologies are Being Successfully Integrated in Industry**	**AGILE**	**Conference**	**Qualitative**	**No Specific Domain**	**Experience papers**	**framework /method**	**Process management**	**User-centered design (UCD)**
126	**2013**	**Adikari (2013)**	**Agile user experience design: A design science enquiry**	**The Association for Contemporary Iberian Studies (ACIS)**	**Conference**	**Qualitative**	**No Specific Domain**	**Evaluation research**	**framework /method**	**Process management**	**User Experience**
127	**2012**	**Kuusinen (2012)**	**Agile user experience development in a large software organization: Good expertise but limited impact**	**International Conference on Human-Centered Software Engineering (HCSE)**	**Conference**	**Case study & survey**	**No Specific Domain**	**Solution proposal**	**Lesson learned**	**Managerial/ organizational**	**User Experience**

128	**2008**	**Hussain (2008)**	**Agile user-centered design applied to a mobile multimedia streaming application**	**HCI and Usability for Education and Work**	**Book Chapter**		**Mobile Industry**	**Experience papers**	**Lesson learned**	**Managerial/ organizational**	**User-centered design (UCD)**
129	**2014**	**Schwartz (2014)**	**Agile-User Experience Design: Does the Involvement of Usability Experts Improve the Software Quality?**	**Advances in Software**	**Journal**	**Literature review & experiment**	**No Specific Domain**	**Experience paper**	**Lesson learned**	**Managerial/ organizational**	**User-centered design (UCD)**
130	**2011**	**Abduljalil (2011)**	**Analysis of human factors in software application design for effective user experience**	**International Conference on Advanced Communications Technology (ICACT)**	**Conference**	**Survey**	**No Specific Domain**	**Evaluation research**	**Model**	**Process management**	**User Experience**
131	**2008**	**Egh (2008)**	**Case study: integrating usability activities in a software development process**	**Behaviour & Information Technology**	**Journal**	**Case study**	**Telecom Domain**	**Experience papers**	**Advice/implications**	**Managerial/ organizational**	**Usability**
132	**2011**	**Lester (2011)**	**Combining agile methods and user-centered design to create a unique user experience: An empirical inquiry**	**Advances in Computer-Human Interactions (ACHI)**	**Conference**		**No Specific Domain**	**Evaluation research**	**Lesson learned**	**Managerial/ organizational**	**User-centered design (UCD)**
133	**2009**	**Hussain (2009)**	**Current State of Agile User-Centered Design: a Survey**	**HCI and Usability for e-Inclusion**	**Book Chapter**	**Survey**	**No Specific Domain**	**Evaluation research**	**Lesson learned**	**Managerial/ organizational**	**User-centered design (UCD)**
134	**2007**	**Yamazaki (2007)**	**Design tools for user experience design**	**Human-Computer Interaction International Conference (HCI)**	**Conference**		**No Specific Domain**	**Experience papers**	**Framework/method**	**Process management**	**User Experience**
135	**2014**	**Hastreiter (2014)**	**Developing UX for collaborative mobile prototyping**	**International Conference on Design, User Experience and Usability (DUXU)**	**Conference**		**Mobile Industry**	**Solution proposal**	**Framework/method**	**Tools and technology**	**User-centered design (UCD)**
136	**2009**	**Khodadadeh (2009)**	**Emotional design: Study of the colour preferences of Iranian users**	**International Conference on Engineering and product Design Education(E&PDE)**	**Conference**	**Case study**	**No Specific Domain**	**Evaluation research**	**Lesson learned**	**Managerial/ organizational**	**Emotion**
137	**2015**	**Brhel (2015)**	**Exploring principles of user-centered agile software development: A literature review**	**Agile Usability Journal**	**Journal**	**systematic literature review**	**No Specific Domain**	**Evaluation research**	**Lesson learned**	**Managerial/ organizational**	**User-centered design (UCD)**

138	**2007**	**Specker (2007)**	**Exploring usability needs by human-computer interaction patterns**	**Human-Computer Interaction International Conference (HCI)**	**Conference**		**No Specific Domain**	**Opinion papers**	**Framework/method**	**Process management**	**Usability**
139	**2014**	**Jin (2014)**	**From the user experience to optimization design in App development process**	**Workshop on Advanced Research and Technology in Industry Applications (WARTIA)**	**Conference**	**Survey**	**Mobile Industry**	**Solution proposal**	**Framework/method**	**Process management**	**User Experience**
140	**2012**	**Yamakami (2012)**	**From User Experience to Social Experience: A New Perspective for Mobile Social Game Design**	**International Conference on Ubiquitous Intelligence and Computing (UIC/ATC)**	**Conference**	**Observation**	**Mobile Industry**	**Opinion papers**	**Guidelines**	**Managerial/ organizational**	**User Experience**
141	**2014**	**Butt (2014)**	**Handling tradeoffs between agile and usability methods**	**International Conference on Computer and Information Sciences (ICCOINS)**	**Conference**	**Literature review**	**No Specific Domain**	**Evaluation research**	**Model**	**Tools and technology**	**Usability**
142	**2012**	**Kuusinen (2012)**	**How to make agile UX work more efficient: Management and sales perspectives**	**Nordic Conference on Human-Computer Interaction (NordiCHI)**	**Conference**	**Survey & case study**	**No Specific Domain**	**Experience papers**	**Advice/implications**	**Managerial/ organizational**	**User Experience**
143	**2003**	**Ferre (2003)**	**Improving software engineering practice with HCI aspects**	**Scottish Educational Research Association (SERA)**	**Conference**	**survey**	**No Specific Domain**	**Solution proposal**	**Framework/method**	**Process management**	**Human-computer interaction (HCI)**
144	**2014**	**Kuusinen (2014)**	**Improving UX work in scrum development: A three-year follow-up study in a company**	**International Conference on Human-Centered Software Engineering (HCSE)**	**Conference**	**Survey**	**No Specific Domain**	**Experience papers**	**Lesson learned**	**Managerial/ organizational**	**User Experience**
145	**2007**	**D\ chting (2007)**	**Incorporating user centered requirement engineering into agile software development**	**Human-Computer Interaction International Conference (HCI)**	**Conference**		**No Specific Domain**	**Opinion paper**	**Lesson learned**	**Managerial/ organizational**	**User-centered design (UCD)**
146	**2014**	**Jurca (2014)**	**Integrating Agile and User-Centered Design: A Systematic Mapping and Review of Evaluation and Validation Studies of Agile-UX**	**AGILE**	**Conference**	**Systematic mapping study & Literature review**	**No Specific Domain**	**Evaluation paper**	**Guidelines**	**Managerial/ organizational**	**User-centered design (UCD)**
147	**2014**	**Salah (2014)**	**Integrating agile development processes and user centred design - a place for usability maturity models?**	**International Conference on Human-Centered Software Engineering (HCSE)**	**Conference**	**Case study**	**No Specific Domain**	**Evaluation paper**	**Model**	**Managerial/ organizational**	**User-centered design (UCD)**

148	**2012**	**Felker (2012)**	**Integrating UX with scrum in an undergraduate software development project**	**Special Interest Group on Computer Science Education (SIGCSE)**	**Conference**		**No Specific Domain**	**Experience paper**	**Lesson learned**	**Managerial/ organizational**	**User Experience**
149	**2009**	**Komischke (2009)**	**Integrating User Experience into a Software Development Company–A Case Study**	**Human Centered Design (HCD)**	**Conference**	**Case study**	**No Specific Domain**	**Experience paper**	**Guidelines**	**Managerial/ organizational**	**User Experience**
150	**2011**	**Viikki (2011)**	**Integrating Human-Centered Design into Software Development: An Action Research Study in the Automation Industry**	**Software Engineering and Advanced Applications (SEAA)**	**Conference**	**Action research**	**Automotive Domain**	**Experience paper**	**Lesson learned**	**Managerial/ organizational**	**Human-centered design (HCD)**
151	**2015**	**Ovad, T**	**The Prevalence of UX Design in Agile Development Processes in Industry**	**AGILE**	**Conference**	**Interviews**	**No Specific Domain**	**Experience paper**	**Guidelines**	**Process management**	**User Experience**
152	**2015**	**Kuusinen, K**	**Task Allocation Between UX Specialists and Developers in Agile Software Development Projects**	**INTERACT**	**Conference**	**Survey**	**No Specific Domain**	**Philosophical paper**	**Lesson learned**	**Process management**	**User Experience**
153	**2015**	**Choma, J**	**Towards an Approach Matching CMD and DSR to Improve the Academia-Industry Software Development Partnership: A Case of Agile and UX Integration**	**Human-Computer Interaction International Conference (HCI)**	**Conference**	**Case study**	**No Specific Domain**	**Experience paper**	**Guidelines**	**Process management**	**User Experience**
154	**2015**	**Lima Peres, A**	**Towards a framework that promotes integration between the UX design and SCRUM, Aligned to CMMI**	**Conference on Information Systems and Technologies (CISTI)**	**Conference**	**Systematic literature review**	**No Specific Domain**	**Philosophical paper**	**Framework/methods**	**Process management**	**User Experience**
155	**2015**	**Kuusinen, K**	**Overcoming challenges in agile user experience work: Cross-case analysis of two large software organizations**	**Software Engineering and Advanced Applications (SEAA)**	**Conference**	**Survey**	**Sales Domain**	**Solution proposal**	**Theory**	**Managerial/ organizational**	**User Experience**
156	**2015**	**Seyam, M**	**Enhancing usability through agility: pair programming for a practice-oriented integration approach**	**International Conference on Collaboration Technologies and Systems (CTS)**	**Conference**	**Literature Review**	**Mobile Industry**	**Solution proposal**	**Theory**	**Process management**	**Usability**

157	**2015**	**Yan Sun**	**Key Factors Affecting User Experience of Mobile Recommendation Systems**	**International MultiConference of Engineers and Computer Scientists (IMECS)**	**Conference**	**Literature Review**	**Mobile Industry**	**Opinion paper**	**Frameworks/methods**	**Managerial/ organizational**	**User Experience**
158	**2015**	**Zapata, C**	**Integration of Usability and Agile Methodologies: A Systematic Review**	**International Conference on Design, User Experience and Usability (DUXU)**	**Conference**	**Systematic literature review**	**No Specific Domain**	**Experience paper**	**Guidelines**	**Process management**	**Usability**
159	**2015**	**AP van der Meer**	**The synergy between user experience design and software testing**	**International Conference on Software Engineering and Formal Methods (SEFM)**	**Conference**	**Case study**	**No Specific Domain**	**Philosophical paper**	**Guidelines**	**Managerial/ organizational**	**User Experience**
160	**2015**	**Chek Tien Tan**	**Tool Design Jam: Designing Tools for Games User Research**	**Computer-Human Interaction in Play (CHI PLAY)**	**Conference**	**Interviews**	**Online games**	**Experience paper**	**Guidelines**	**Tools and technology**	**User Experience**
161	**2015**	**Silva da Silva**	**Usability Evaluation Practices within Agile Development**	**Hawaii International Conference on System Sciences (HICSS)**	**Conference**	**Observation**	**No Specific Domain**	**Evaluation Research**	**Frameworks/methods**	**Process management**	**Usability**
162	**2015**	**T Di Mascio**	**If Usability Evaluation and Software Performance Evaluation Shook Their Hands: A Perspective**	**International Conference of Product Focused Software Development and Process Improvement (Profes)**	**Conference**		**No Specific Domain**	**Evaluation Research**	**Theory**	**Managerial/ organizational**	**Usability**
163	**2015**	**Springett, M**	**Integrating the strengths of cognitive emotion models with traditional HCI analysis tools**	**Universal Access in the Information Society**	**Journal**		**No Specific Domain**	**Philosophical paper**	**Model**	**Managerial/ organizational**	**Human-computer interaction (HCI)**
164	**2015**	**Law, E.L.C**	**Whose Experience Do We Care About? Analysis of the Fitness of Scrum and Kanban to User Experience**	**International Journal of Human-Computer Interaction**	**Journal**	**Semistructured interviews**	**Manufacturing domain**	**Experience paper**	**Lesson Learned**	**Process management**	**User Experience**
165	**2015**	**Hokkanen, L**	**UX work in startups: Current practices and future needs**	**Agile Processes, in Software Engineering, and Extreme Programming**	**Conference**	**Semi-structured interviews**	**Mobile**	**Philosophical paper**	**Lesson learned**	**Process Management**	**User Experience**

166	**2015**	**González-González, C.S.**	**Agile human centered methodologies to develop educational software [Metodologías ágiles centradas en personas para desarrollar software educativo]**	**Agile Usability Journal**	**Journal**		**Mobile**	**Evaluation Research**	**Guidelines**	**Process Management**	**User-centered design (UCD)**
167	**2015**	**Silva, W**	**Integrating the usability into the software development process: A systematic mapping study**	**International Conference on Enterprise Information Systems (ICEIS)**	**Conference**	**Systematic mapping study**	**No Specific Domain**	**Philosophical paper**	**Lesson learned**	**Managerial/ Organizational**	**Usability**
168	**2015**	**Da Silva**	**Usability evaluation practices within agile development**	**Hawaii International Conference on System Sciences (HICSS)**	**Conference**	**Case Study**	**No Specific Domain**	**Opinion paper**	**Lesson learned**	**Process Management**	**Usability**
169	**2015**	**Wale-Kolade, A.Y**	**Integrating usability work into a large inter-organisational agile development project: Tactics developed by usability designers**	**Journal of Systems and Software**	**Journal**	**Semi-structured interviews**	**Sales**	**Experience paper**	**Guidelines**	**Process Management**	**Usability**
170	**2015**	**Salah, D**	**Observations on utilising usability maturity model-human centredness scale in integrating agile development processes and user centred design**	**International Spice Conference**	**Conference**	**Case Study**	**Telecom**	**Evaluation Research**	**Guidelines**	**Process Management**	**Usability**