KARINA PAULA DE CAMARGO CURCIO

AN APPROACH FOR USER EXPERIENCE DESIGN INTEGRATION INTO AGILE SOFTWARE DEVELOPMENT

Doctoral dissertation submitted in fulfillment of the requirements for the degree of Doctor of Philosophy in Informatics in the Graduate Program in Informatics of the Pontifical Catholic University of Paraná, Brazil.

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DECLARAÇÃO

Declaro para os devidos fins que a aluna KARINA PAULA DE CAMARGO CURCIO, defendeu sua tese de Doutorado intitulada "AN APPROACH FOR USER EXPERIENCE DESIGN INTEGRATION INTO AGILE SOFTWARE DEVELOP", na área de concentração Ciência da Computação, no dia 14 de outubro de 2021, no qual foi aprovada.

Declaro ainda que foram feitas todas as alterações solicitadas pela Banca Examinadora, cumprindo todas as normas de formatação definidas pelo Programa.

Por ser verdade, firmo a presente declaração.

Curitiba, 09 de dezembro de 2021.

Prof. Dr. Emerson Cabrera Paraiso
Coordenador do Programa de Pós-Graduação em Informática
Pontifícia Universidade Católica do Paraná

Queridos pais, dedico esta tese a vocês.

Obrigada pelo apoio incondicional e por nunca me deixarem desistir dos meus sonhos.

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Imagination is more important than science, because science is limited, while imagination encompasses the whole world.

Albert Einstein.

ABSTRACT

The agile software development methodologies, after the emergence of the Agile Manifesto, are gaining more space and consolidating in the market. The focus of these methodologies is on the development of products based on the core functionalities to be delivered to customers, in order to quickly add value. Non-functional requirements, such as usability and user experience, are little explored during agile software development. Although there is a lot of interaction between the development team and their customers, with constant feedback, what we see is that the results of software products are often useful but not necessarily usable. On the other hand, companies are increasingly interested in providing positive user experiences. In this way, this work intends to create an approach to enable usability integration in agile software development focusing on the user experience practices, artifacts and team integration. To accomplish this goal the research was separated into four phases: an initial planning with the execution of an exploratory research to delimit the objectives and initial questions, an exploratory phase composed of a literature review and multiple case studies; a development phase to propose a new approach to integrate usability and agile software development focusing on the user experience; and evaluation and conclusion phase to perform an evaluation, collect the results and analyze them. The case studies were conducted with seven companies and sixteen employees with different roles. The results showed some deficiencies regarding the use of artifacts, practices, and tools to exploit the user experience. In relation to roles and teams, it was also possible to identify different forms of team composition, but a limitation of resources in the area of UX/UI design was explicit. Based on the information that was gathered, the new approach UXIAD was created and put into practice so that it could be evaluated. For this, two questionnaires were applied. One focused on the users of the approach and the other on the users of the systems that were developed using the new approach. In general, the results obtained from the questionnaire were positive. Despite having identified points of improvement in the process, we achieved the research objective of creating an approach capable of integrating agile development with usability, aiming at better experiences for the final users.

Keywords: agile software development, usability, user experience, user-centered design.

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LIST OF ACRONYMS

Agile-UX	Agile-User Experience
ATM	Automated Teller Machine
AUCDI	Agile and User Centred Design Integration
BoB	Best of Both Worlds
DSDM	Dynamic Software Development Method
ERP	Enterprise Resource Planning
FDD	Feature-Driven Development
GDD	Goal-Directed Design
HCI	Human-Computer Interaction
IEC	International Electrotechnical Commission
iOS	iPhone Operating System
ISO	International Organization for Standardization
IxD	Interaction Design
MCT	Ministry of Science and Technology
MPS-BR	Brazilian Software Process Improvement
MVP	Minimum Viable Product
NDA	Non-Disclose Agreement
SQuaRE	Software Product Quality Requirements and Evaluation
TAM	Technology Acceptance Model
TR	Technical Report
UCASD	User-Centered Agile Software Development
UCD	User-Centered Design
UCDS	User-Centered Design Specialist
UI	User Interface

UML	Unified Modeling Language
UX	User Experience
VDTs	Visual Display Terminals
XP	Extreme Programming

CHAPTER 1 - INTRODUCTION

Agile software development processes focus on communication, developer collaboration and delivery of working software early and continuously (LARUSDOTTIR; GULLIKSEN; CAJANDER, 2016). Due to these characteristics, agile methodologies were quickly absorbed by the industry, as shown by DIGITAL.AI in the 15th Annual State of Agile Report (DIGITAL.AI, 2021).

Although the agile methodologies like Scrum (SCHWABER; BEEDLE, 2001), Feature Driven Development (FDD) (PALMER; FELSING, 2002) and Extreme Programming (XP) (BECK; ANDRES, 2004) and have gained market space and accelerated delivery of value to the customer in a short time, some important aspects of software engineering, such as quality, have been neglected according to Inayat et. al (2015). In a recent mapping study about agile requirements engineering presented by (CURCIO et al., 2018), the results showed that agile methodologies have not adequately modeled non-functional requirements and their potential solutions. Due to this fact sometimes they are criticized for not having explicit practices for non-functional requirements.

Non-functional requirements such as performance/efficiency, compatibility, usability, reliability, security, maintainability, and portability are part of a quality model of software products defined by the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC). They have defined a set of standards that are constantly updated, for working with software product quality issues. The ISO/IEC 9126-1:2001 (ISO/IEC 9126-1, 2001) defines a product quality model that includes characteristics and subcharacteristics of quality. Usability, as already mentioned above, is a characteristic of software quality and was defined as “degree to which a product or system can be used by specified users to achieve specific goals with effectiveness, efficiency and satisfaction in a specified context of use”. This standard was substituted in 2011 by the standards of ISO/IEC 25000 family (ISO/IEC 25000, 2014).

Usability has become crucial for economic success in highly competitive markets (BRHEL et.al, 2015). According to Nielsen (2012) “usability is a necessary

condition for survival". When users encountered difficulties to navigate on websites, get lost on the navigation or if the website fails, they will probably leave. It is also a matter of employee productivity when it is related to internal applications and intranets because it can reduce their productivity.

Another very important aspect of the software products being generated nowadays is the user experience (UX). It was defined by (ISO 9241-210, 2010) as "a person's perceptions and responses that result from the use or anticipated use of a product, system or service". According to Garrett (2011), UX is perceived as critical criteria in differentiating between a successful and unsuccessful product. While the goals of usability studies are focused on user efficiency and productivity interacting with the system, those related to user experience are focused on understanding the way users deal with an interactive product and their feelings (SANTOS; KON, 2011). UX highlights non-utilitarian aspects, shifting the focus to the user affect and sensation (LAW et al., 2008). Preece, Rogers and Sharp (2019) in their textbook state that, in addition to the primary focus of improving usability, there is a concern that aim to focus in UX to create interactive products that are enjoyable, satisfying, motivating, aesthetically pleasing, entertaining, helpful, fun, rewarding, supportive of creativity, and emotionally fulfilling. These aspects have attracted different areas of study such as Interaction Design (IxD), Human-Computer Interaction (HCI) and marketing. Through them, the study of usability and UX can have complementary results when integrated with agile development. According to Choma, Zaina and Beraldo (2016) the interest in integrating these areas has been increased in the last decade in order to provide high quality UX and usability as an important item to add value to software products.

However, according to the literature, some weak points regarding this integration have been identified, as the focus of agile practitioners are to add value to the customer. In agile development there is no defined role that represents a user interface specialist[1], an interaction designer[2] or user experience designer[3] (CONSTANTINE, 2002). This role in agile teams is not clear and largely overlooked (SALAH; PAIGE; CAIRMS, 2014). According to Armitage (2004) agile practitioners usually neglect the user experience, hardly discuss about user's involvement or users' interface and focus on delivering the working software. Moreover, none of the major

[1] https://www.interaction-design.org/literature/topics/ui-design
[2] https://www.interaction-design.org/literature/topics/interaction-design
[3] https://uxpa.org/about-ux/

agile methods include guidance for the practitioner to develop usable software (LEE; STEVENS; MCCRICKARD, 2009).

As described by (SOHAIB; KHAN, 2010), “practices for understanding, eliciting usability and user requirement and evaluating agile systems for usability and user experience are generally considered deficient”. Usually the artifacts used by the agile development team are focused on maximizing the transparency of information, supporting decisions during the development process, as well as facilitating communication. None of these artifacts are really focused on understanding the user experience as a whole. The consequence of this is that currently various software products are being created, no matter what the outcome of the user experience.

These related problems lead us to the following questioning: **How to integrate usability with agile software development focusing on user experience?**

In the last years many studies have been developed to incorporate usability and UX into agile software development. The proposed solutions focus on different dimensions, such as those proposed by (BARKSDALE; MCCRICKARD, 2012) through **practices, processes, technology, people and social**. In the work presented by (MAGÜES; CASTRO; ACUÑA, 2016a) four dimensions (processes, practices, technology and team) were taken into account for the classification of the selected works in their systematic mapping study. They used a Venn diagram to represent the results obtained as demonstrated in Figure 1-1.

Their analysis reveals that practice and process integration are strongly represented. Process integration was represented by 76 out of 161 studies, which represent 47,83% of the total. Practice integration is the second largest group with 31 publications, representing 19,25% of all primary studies analyzed. **The absence of studies at the intersection of processes, practices and teams’ dimensions, draw our attention and indicated a research gap that needs to be explored.**

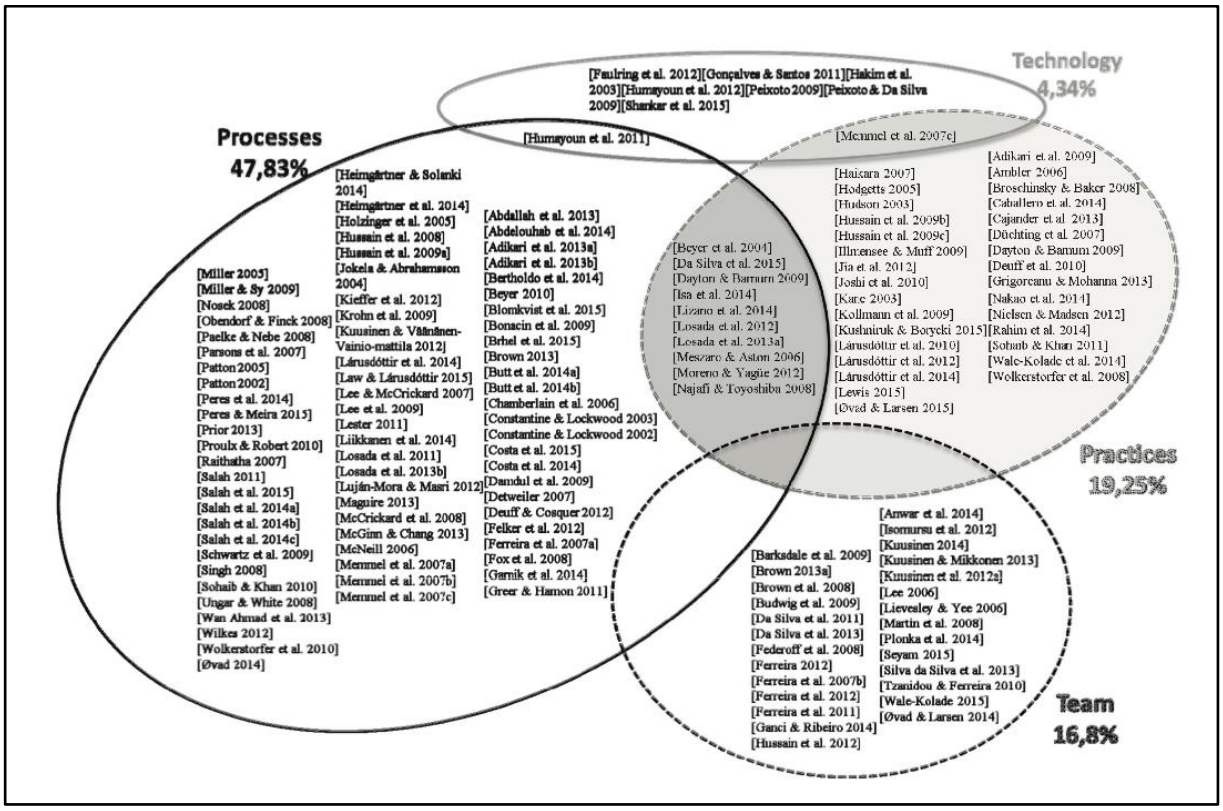

Figure 1-1. Classification of the publications by integration type according to (MAGÜES; CASTRO; ACUÑA, 2016a).

In the work proposed by (BRHEL et al., 2015) four out of these five dimensions were also used to classify the selected studies: process, practices, people/social and technology. The goal of this study was to capture the current state of the art in user-centered agile software development (UCASD) approaches and derive generic principles. Five generic principles were identified for the integration of agile development to user-centered design: (1) separate product discovery and product creation, (2) iterative and incremental design and development, (3) parallel interwoven creation tracks, (4) continuous stakeholder involvement, and (5) artifact-mediated communication. The last principle “artifact-mediated communication” is a new topic not much explored yet (SILVA et al., 2018). According to Choma, Zaina and Beraldo (2016), **few proposals concern to incorporate design methods and suitable artifacts to support the communication between designers and agile teams**. In the most recent mapping study, presented by (GARCIA; SILVA; SILVEIRA, 2017), a total of 20 artifacts groups were found related to the analyzed research papers. This study emphasized the importance of artifacts to increase teams’ communication. Not only communication between the team but also the integration of activities and their

respective roles within the agile development process has been discussed (FERREIRA; NOBLE; BIDDLE, 2007b), (GANCI; RIBEIRO, 2014), (PLONKA et al., 2014), (LIEVESLEY; YEE, 2006).

The majority of the studies that focused on process integration criteria, proposed the integration through the user-centered design (UCD) approach as a form of solution (SY, 2007), (SILVA et al., 2011), (KUUSINEN, 2016). The definition of UCD is also based on the ISO 9241-210 (Ergonomics of human-system interaction -- Part 210: Human-centred design for interactive systems) (ISO 9241-210, 2010). The standard serves as guidance to design processes managers, providing requirements and recommendations for human-centred design principles and activities throughout the life cycle of computer-based interactive systems. This standard assumes no particular design process nor does it describe all the different activities required to ensure an effective system design. It is complementary to existing methodologies and provides a user-centered perspective.

In a study presented by (SALAH; PAIGE; CAIRMS, 2015) the commonalities and differences between agile processes and user centred design were highlighted as represented in Figure 1-2.

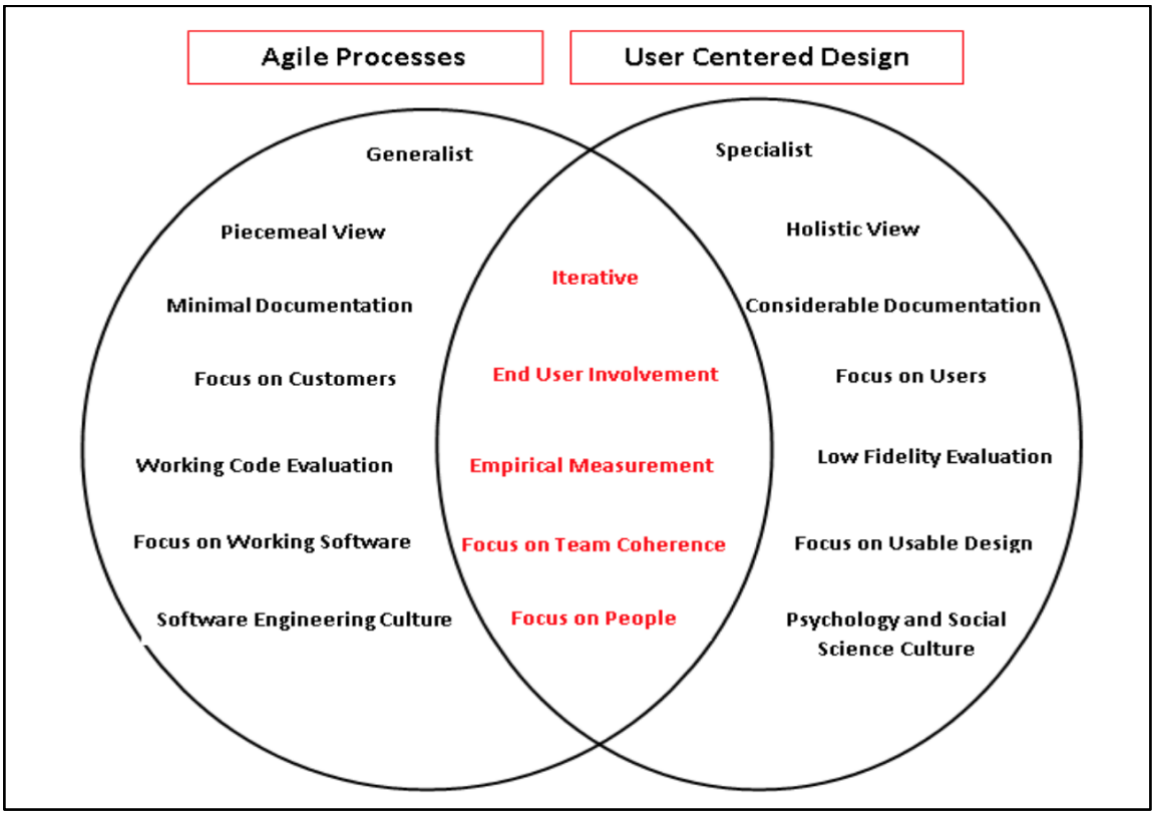

Figure 1-2. Commonalities and Differences between Agile and User Centered Design according to (SALAH, PAIGE, CAIRNS, 2015).

While the agile processes have a piecemeal view, working with a minimal documentation, focusing on customers and working code and are based on software engineering culture, the user centered design process has a holistic view, working with a considerable documentation, focusing on users and usable design and is based on psychology and social science culture. The idea therefore is to try to achieve balance through the intersection of the two processes. This balance is somewhat challenging, as we seek to find an interactive model, with direct user involvement, with empirical measurements, focusing on people and team coherence.

Even having found several proposals that discuss the integration of usability to agile development, none of them proposed:

- Practices to really anticipate end user's problems before starting the sprints, and not just use sprint zero to solve them. This can lead to the development of products that focus only on functional issues and do not value usability and user experience aspects.
- A mutual understanding at the beginning of the project about the actual user journey and what the product should be, including technical, business and user experiences perspectives. The absence of this shared vision can lead to misunderstanding of requirements when delivered to designers and to longer periods of development, since correction requests may be more frequents.
- An artifact to properly document the most critical requirements that involve user's feelings. Most of the proposals presented use only navigable prototypes to document and approve usability issues. But this type of artifact is not able to capture and document the user's feelings in a reliable way as well as the opportunities for improvement of the current user journey.
- Minimum documentation to properly document critical iteration points to facilitate future maintenances.
- Guidance for identifying critical user's iteration points to conduct usability and user experience tests. The lack of course added to the short time to execute this type of tests leads to the simple disregard of these activities by the development team.

In this way it is necessary to propose a new approach to handle these identified points, which are very relevant and important to integrate usability issues in agile software development focusing on a better user experience.

1.1 Research Objectives

According to the scenario described, the general objective of this work is **to create an approach to enable usability integration in agile software development focusing on the user experience practices, artifacts and team integration.** The specific objectives are defined to meet the general objective:

i. To investigate in enterprise environments how usability and user experience are handled in the context of agile software development and what are the main difficulties for this integration process.

ii. To build an approach to integrate usability with agile software development focusing on user experience.

iii. To evaluate the proposed approach.

The accomplishment of these goals leads us to answer the main question of this research: **How to integrate usability with agile software development focusing on user experience?**

In this context it is expected that the creation of a new approach, where practices, roles and artifacts linked to user experience, can help organizations to improve the software development processes and quality of the created products.

1.2 Delimitation of scope

Initially it is necessary to identify the universe of companies, which will be objects of study in this proposal. Therefore, only the software development companies that use the agile methodologies were considered in this study, in order to limit its scope, since usability and user experience can be worked in different ways. This work is not intended to describe the only way to achieve usability and the best user experience, since different strategies have been previously studied and encourage the application of different ways to achieve better usability results. The proposal is that this new approach can support companies in terms of practices, artifacts and team integration. The aim is to improve the activities that involve software development as well as achieve better results in terms of usability of the products and the experience of end users.

1.3 Research Approach

In order to execute this research, we separated it in four steps:

- **Step 1** – **Initial Planning:** execution of an exploratory research to delimit the research theme and establish the objectives and initial questions.
- **Step 2** – **Exploratory Phase:** execution of a literature review to map the existing approaches to integrate usability and user experience into the agile software development. In this phase will also be carried out the definition of the research methods. The idea is to execute multiples case studies to investigate how usability and user experience are handled in the context of agile software development.
- **Step 3** – **Development:** conception of a new approach to integrate usability into agile development, focusing on better user experiences. The aim of this new approach is to overcome the main difficulties mapped in the literature and in industry.
- **Step 4 – Evaluation and Conclusion:** carrying out the evaluation and the analysis of the new approach, extracting generalizations and conclusions.

1.4 Document Structure

This document is structured as follows:

- Chapter 1 presented, aims to provide an overview about the objective and motivation of this research.
- Chapter 2 presents the background of the research field, including the basics of agile development, usability, user experience and user-centered design needed to the reader's understanding of the proposed study, and also the results of the literature review about the existing approaches to integrate usability into the agile software development.
- Chapter 3 presents the research characterization, approach and strategy.
- Chapter 4 presents the case studies and describes the conclusions obtained from the results.
- Chapter 5 presents the new proposed approach.

- Chapter 6 presents the results obtained through the evaluation of the new proposed approach.
- Chapter 7 presents the final considerations of the research, including the study relevance and contributions as well as its limitations and future works.

1.5 Considerations about this chapter

In this chapter the motivation that led to the development of this research was presented. In order to do so, we approached themes such as agile software development, as well as the lack of concern with non-functional requirements, specifically with usability issues. With the intention of leading the reader to the main research question, some observations were also made related to previous studies that presented some proposals to integrate usability and user experience in agile software development. After the presentation of the main objective and the specific objectives of the research, were also presented the stages that were structured for the elaboration of this research, as well as the delimitation of its scope.

In order to lead the reader to have the complete understanding of this proposal, it will be necessary to present the fundamental concepts that are addressed in it. For this reason, Chapter 2 was produced and will serve as the basis of knowledge for the reader.

CHAPTER 2 - LITERATURE REVIEW

This chapter presents the results of the literature review on the main themes involved in this research project, starting with the concepts of agile software development and detailing the Scrum framework. It also presents the theoretical basis related to the concept of usability and the ISO/IEC standards that are directly related to it. Finally, some previously proposed literature reviews related to the integration of usability into agile development and also some initiatives already developed in this context to support the later creation of the approach proposed in this work.

2.1 Agile Software Development

In early 2001 seventeen software development professionals met in Utah to discuss and share new approaches to software development. As a result of this meeting the "Manifesto for Agile Software Development" (AGILE MANIFESTO, 2001) was created. The manifesto consists of a group of values and principles, which aims to help people to understand the concept of the agile software development. The values stated were: individuals and interactions over processes and tools, working software over comprehensive documentation, customer collaboration over contract negotiation, responding to change over following a plan. Since the creation of the Manifesto several methods and frameworks for agile software development emerged based on the values and principles established there. In their article (DINGSØYR et al., 2012) synthesizes the main methods of agile software development: Crystal methodologies (COCKBURN, 2004), Dynamic Software Development Method (DSDM) (STAPLETON, 2003), Feature-Driven Development (FDD) (PALMER; FELSING, 2002), Lean Software Development (POPPENDIECK; POPPENDIECK, 2003), Scrum (SCHWABER; BEEDLE, 2001) and eXtreme Programming (XP) (BECK; ANDRES, 2004). Agile methods were established to make the software development a simple process and better respond to customer needs. As described by (DINGSØYR; DYBÅ; MOE, 2010) agile methods "are iterative, with focus on teamwork, client-developer collaboration, customer feedback throughout the software project lifecycle,

and support for advance product delivery". The Agile Manifesto emphasize in giving more value to the customer collaboration, individuals and interactions producing a minimum documentation and incremental features. With this way of working is intended to have early and continuous delivery to the customer and receive a continuous feedback. This has been identified as a successful process, as the frequent deliveries make it easier to get the customer closer and involved from the beginning of the project. However, the focus on delivering functionalities can have some usability costs as the agile methods usually have short iterations and minimal up-front design.

According to (SCHWABER; SUTHERLAND, 2017) “Scrum is a framework for developing, delivering, and sustaining complex products”. It is one of the most common agile development processes that use iterative and incremental practices. It is based on a rugby metaphor and is basically composed by the team, events and artifacts, as represented in Figure 2-1.

The team is composed by: a product owner, a scrum master and the development team. The events are described by sprints, sprint planning’s, daily scrum meetings, sprint review and sprint retrospective. The sprints are the heart of the Scrum and are a time-box of a month or less, where potentially releasable products are created and incremented. The artifacts used are: the product backlog and the sprint backlog. The product backlog is an ordered list of all requirements needed in the new product, and the responsible for maintaining this document is the product owner. The sprint backlog is a set of product backlog items and is a forecast for the development team. The scrum master is responsible for promoting the Scrum and acts as a servant-leader for the scrum team. The scrum master helps everyone to understand the scrum theory, practices, rules and values.

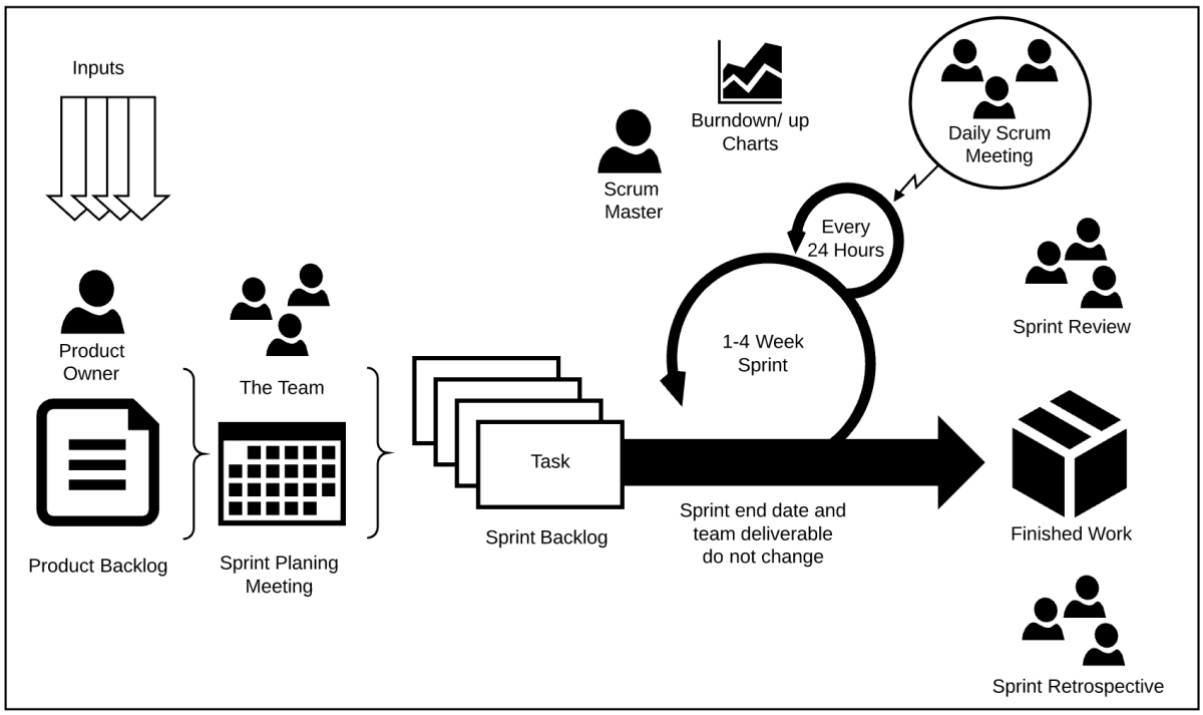

Figure 2-1. Scrum Framework based on (SCHWABER; SUTHERLAND, 2017).

2.2 Quality of Software

In 2001, the ISO standardized the concept of software product quality and published the ISO/IEC 9126-1:2001 (ISO/IEC 9126-1, 2001) standard. This standard is divided into four parts:

1) ISO/IEC 9126-1 Product Quality Model (ISO/IEC 9126-1, 2001);
2) ISO/IEC TR 9126-2 External Metrics (ISO/IEC TR 9126-2, 2003);
3) ISO/IEC TR 9126-3 Internal Metrics (ISO/IEC TR 9126-3, 2003);
4) ISO/IEC 9126-4 Quality in Use Metrics (ISO/IEC TR 9126-4, 2004).

Through the standard, six characteristics were specified for the software product model for internal and external quality: functionality, reliability, usability, efficiency, maintainability, and portability. Each characteristic is composed of a set of related subcharacteristics. According to the ISO/IEC 9126-1:2001 standard, the quality of the process contributes to improving the quality of the product, and the product contributes to improving the quality in use, as shown in Figure 2-3.

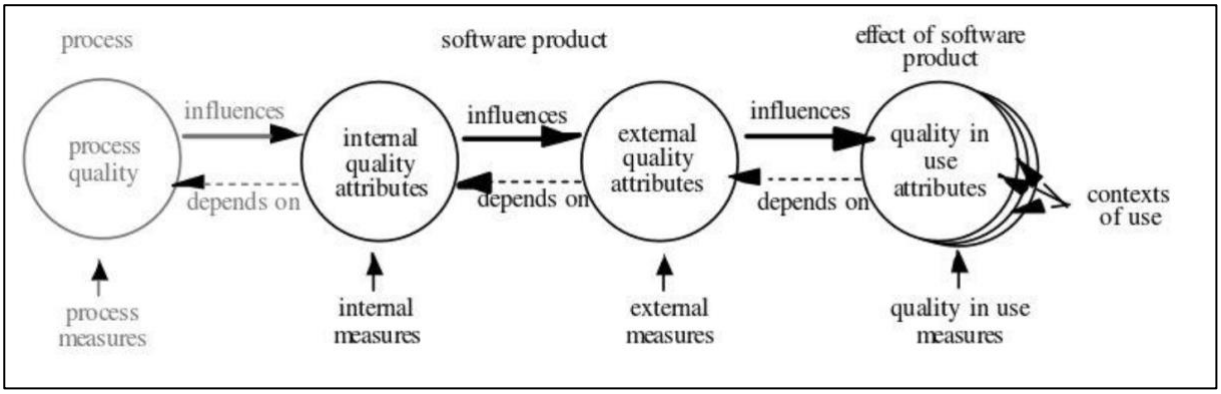

Figure 2-2. Quality in the life cycle, according to the ISO/IEC 9126-1:2001 standard.

The quality in use model in (ISO/IEC 9126-1, 2001) defines four characteristics related to outcomes of interaction with a system: effectiveness, productivity, satisfaction and safety. Each characteristic is also composed of a set of related subcharacteristics.

The software product's quality can be assessed by measuring the internal attributes (typically, static measurements of intermediate products), external attributes (typically by measuring the behavior of the code when executed) and, finally, the attributes of quality in use.

Due to the importance of these standards and the wide adoption of their use, they are constantly being reviewed. Subsequently, a new series of standards was created by the ISO/IEC, called SQuaRE (Software Product Quality Requirements and Evaluation), which became known as the ISO/IEC 25000 family of standards (ISO/IEC 25000, 2014). This standard was divided into five parts:

1) ISO/IEC 25000 – Quality Management (ISO/IEC 25000, 2014);
2) ISO/IEC 25010 – Quality Model Division (ISO/IEC 25010, 2011);
3) ISO/IEC 25020 – Quality Measurement Division (ISO/IEC 25020, 2007);
4) ISO/IEC 25030 – Quality Requirements Division (ISO/IEC 25030, 2007);
5) ISO/IEC 25040 – Quality Assessment Division (ISO/IEC 25040, 2011).

Through the standard, eight characteristics were specified for the software product model: functionality suitability, performance/efficiency, compatibility, usability, reliability, security, maintainability, and portability. For the quality in use model five

characteristics related to outcomes of interaction with a system were defined: effectiveness, efficiency, satisfaction, freedom from risk and context coverage.

The overall objective of creating a set of SQuaRE standards was to obtain a logically organized, rich, and unified series covering two main processes: the specification of software quality requirements and the evaluation of software quality, supported by a process measuring software quality.

2.2.1 Usability

The term “usability” is related to the quality of software products as well as to ergonomics, Interaction Design (IxD) and Human-Computer Interaction (HCI). According to (BEVAN, 2001), international standards for HCI and usability can be classified in four categories:

1) The use of the product (effectiveness, efficiency and satisfaction in a particular context of use);
2) The user interface and interaction;
3) The process used to develop a product;
4) The capability of an organization to apply user-centered design;

It is important to recognize these categories because the integration of usability and agile software development can be proposed based on these presented categories. The Figure 2-2 illustrates the logical relationships between them, and the final objective is to have an effective, efficient and satisfying product when used in the intended contexts. A prerequisite for this is to have an appropriate interface and interaction. This requires a user-centered design process, which to be achieved consistently requires an organizational capability to support user-centered design approach. In his article (BEVAN, 2001) also described the ISO standards related to usability according to the four categories previously presented. As the general objective of this research is to create an approach that enables the integration of usability in agile development, the idea is that we can focus on the understanding of category 3 (development process) proposed by (BEVAN, 2001).

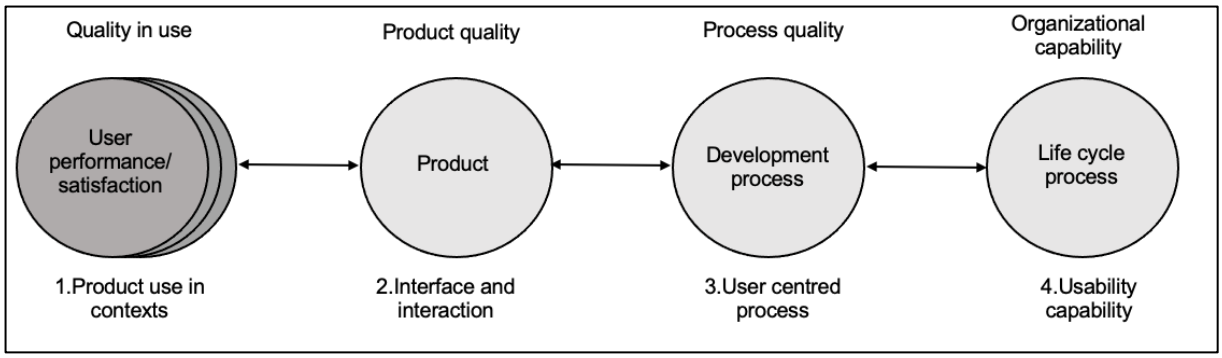

Figure 2-3. Categories of standards for HCI and usability according to (BEVAN, 2001).

In Table 2-1 a summarized and updated version is presented, based on the information previously submitted by him.

Table 2-1. Updated version of HCI and usability standards based on (BEVAN, 2001) proposed categories.

	Principles and recommendations		
	Previously	**Now withdrawn**	**Revised by**
Use in context	ISO/IEC 9126:1991 Software Engineering - Product quality.	ISO/IEC 9126-1:2001 Software Engineering - Product quality- Part 1: Quality model	ISO/IEC 25010: 2011 Systems and Software Engineering – Systems and Software Quality Requirements and Evaluation (SQuaRE) – Systems and Software Quality Model
		ISO/IEC TR 9126-4: 2004 Software Engineering- Product quality - Part 4: Quality in use metrics	ISO/IEC 25022:2016 Systems and Software Engineering – Systems and Software Quality Requirements and Evaluation (SQuaRE) – Measurement of quality in use
	ISO 9241-11: 1998 Ergonomic requirements for office work with visual display terminals (VDTs) – Part 11: Guidance on Usability		ISO 9241-11:2018 Ergonomics of human-system interaction – Part 11: Usability: Definitions and concepts
Software interface and interaction		ISO/IEC TR 9126-2: 2003 Software Engineering-Product Quality-Part 2: External metrics	ISO/IEC 25023:2016 Systems and Software Engineering – Systems and Software Quality Requirements and Evaluation (SQuaRE) – Measurement of system and software product quality

		ISO/IEC TR 9126-3:2003 Software Engineering-Product Quality-Part 3: Internal metrics	ISO/IEC 25023:2016 Systems and Software Engineering – Systems and Software Quality Requirements and Evaluation (SQuaRE) – Measurement of system and software product quality
	ISO 9241-10:1996 Ergonomic requirements for office work with visual display terminals (VDTs) -- Part 10: Dialogue principles		ISO 9241-110:2006 Ergonomics of human-system interaction -- Part 110: Dialogue principles
	ISO 9241-14:1997 Ergonomic requirements for office work with visual display terminals (VDTs) -- Part 14: Menu dialogues **(remains current)**		
	ISO 9241-15:1997 Ergonomic requirements for office work with visual display terminals (VDTs) -- Part 15: Command dialogues **(remains current)**		
	ISO 9241-13:1998 Ergonomic requirements for office work with visual display terminals (VDTs) -- Part 13: User Guidance **(remains current)**		
	ISO 9241: 1998 Ergonomic requirements for office work with visual display terminals (VDTs). Parts (11, 12, 16, 17)	(Part16) - ISO 9241-16:1999 Ergonomic requirements for office work with visual display terminals (VDTs) -- Part 16: Direct manipulation dialogues	(Part 11) - ISO 9241-11:2018 Ergonomics of human-system interaction -- Part 11: Usability: Definitions and concepts (Part 12) - ISO 9241-125:2017 Ergonomics of human-system interaction -- Part 125: Guidance on visual presentation of information (Part 17) - ISO 9241-143:2012 Ergonomics of human-system interaction -- Part 143: Forms
Development process		ISO 13407: 1999 Human-centred design processes for interactive systems	ISO 9241-210:2010 Ergonomics of human-system interaction – Part 210: Human-centred design for interactive systems

Usability capability	ISO/TR 18529: 2000 Ergonomics of human-system interaction - Human-centred lifecycle process descriptions **(remains current)**		

According to ISO/IEC 25000:2014 family the term usability is defined as **"degree to which a product or system can be used to achieve specified goals with effectiveness, efficiency and satisfaction in a specific context of use"**.

Other ISO standards and models also define usability. In (WEICHBROTH, 2018) the author presented a critical literature review aiming to demonstrate the relevant usability definitions and related attributes until that moment. The result of this work was presented by a time-framed knowledge map that provides an in-dept understanding of the observed evolution, as illustrated in Figure 2-4.

Attribute / [Ref. No] & Year	[1] 1991	[2, 3] 1987	[4] 1991	[5] 1993	[6] 1993	[7] 1993	[8] 1994	[9] 1995	[10] 1998	[11] 1999	[12] 2001	[13] 2003	[14] 2006	[15] 2011	[16] 2016	[17] 2018
Effectiveness	●					●		●	●			●	●	●		●
Learnability	●		●	●	●					●	●	●	●		●	
Flexibility	●															
Attitude	●[2]															
Aesthetics		●														
Consistency		●														
Documentation		●														
Human factors		●														
Understandability			●								●				●[1]	
Operability			●								●				●	
Affect				●												
Efficiency				●	●	●		●	●	●[1]		●	●	●		●
Helpfulness				●												
Control				●												
Memorability					●					●[1]						
Errors					●										●[1]	
Satisfaction					●	●	●	●	●	●[1]		●	●	●		●
Reliability in Use										●						
Attractiveness											●				●[1]	
Usability Compliance											●					
Security												●				
Productivity													●			
Safety													●			
Trustfulness													●			
Accessibility													●		●	
Universality													●			
Usefulness													●			

●: Included. [1]: Defined under a similar name. [2]: Attitude has a moderate connotation contrary to satisfaction, thus they are not combined.

Figure 2-4. Usability Attributes of various Standards and Models according to (WEICHBROTH, 2018).

In ISO 9241-11:1998 (Ergonomic requirements for office work with visual display terminals (VDTs) -- Part 11: Guidance on usability) (ISO 9241-11, 1998), usability is defined as **“the extent to which a system, product or service can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use”.** In the current standard ISO 9241-11:2018 the definition of usability has not been changed. But the previously proposed usability framework, where efficiency, effectiveness and satisfaction are shown as a result of usage, has now been adapted to also include new results that include accessibility, user experience and avoidance of usage damage.

The term usability is also associated with other terms like user experience (UX), interaction design (IxD), user-centered design (UCD) and usability engineering, and sometimes erroneously treated as synonyms.

2.3 User-Centered Design

The user-centered design (UCD) is a design process that focuses on user needs and requirements. It was defined by the ISO 13407:1999 (Human-centred design processes for interactive systems), (ISO 13407, 1999) and includes a general process for including human-centred (user-centered) activities throughout a development lifecycle without specifying the exact methods to develop it. This standard is related to ergonomics catalogue and basically defines four activities that form the main cycle of work: specify the context of use, specify the requirements, create design solutions and evaluate the design. This standard has been revised by ISO 9241-210:2010 (Ergonomics of human-system interaction – Part 210: Human-centred design for interactive systems), (ISO 9241-210, 2010).

2.4 User Experience

User experience is also defined by ISO 9241-210:2010 as **“person’s perceptions and responses resulting from the use and or anticipated use of a product, system or service”.** The user experience is thus subjective, and its focus is on use. According to (TULLIS; ALBERT, 2013) while usability is generally considered

the user's ability to use something to complete a task successfully, the user experience has a broader view, looking at the individual's complete interaction, thoughts, feelings and perceptions that result of this interaction.

According to Bevan (2009) user experience is not distinct, and it is an extension of usability. Sharp, Rogers and Preece (2002) have explained this broader view of usability within user experience in terms of user experience goals and usability goals emphasizing that user experience is at a level beyond that of usability. According to them, user experience occurs as a result of achieving usability goals during an interaction as demonstrated in Figure 2-5.

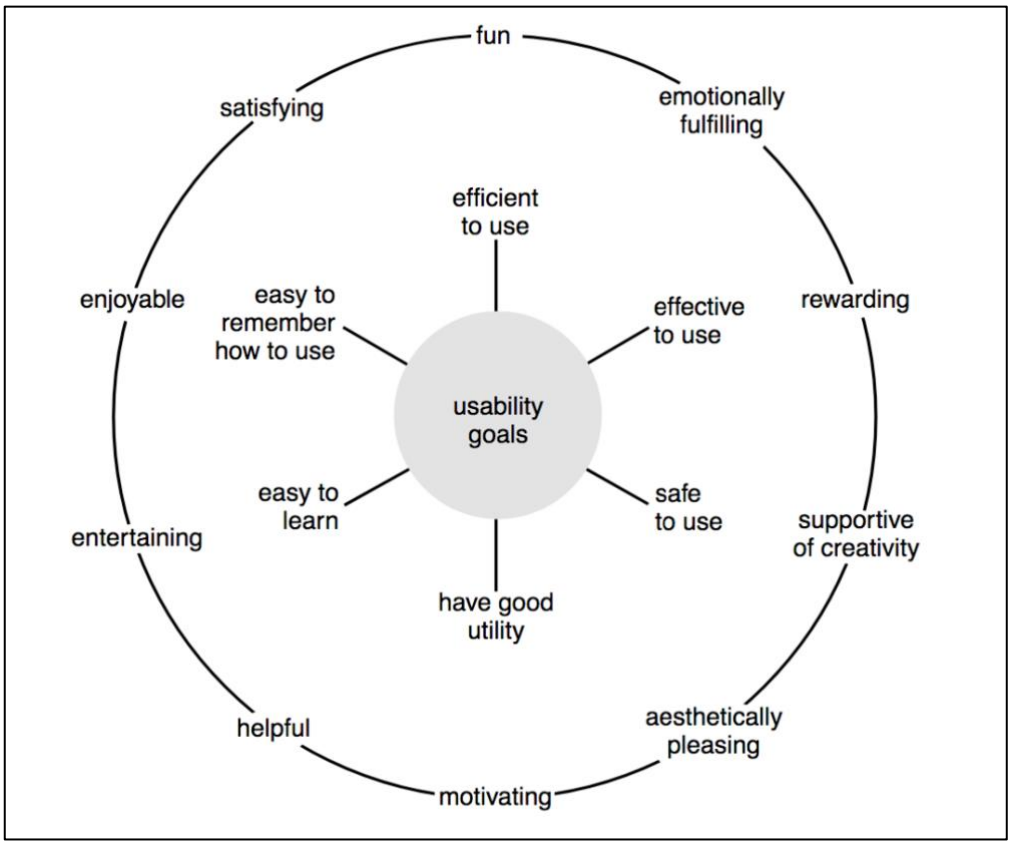

Figure 2-5. Usability and UX goals based on Sharp, Rogers and Preece (2002).

ISO 9241-210:2010 also presented 3 notes, next to the term definition. The first one is related to the UX concept: “user experience includes all the user’s emotions, beliefs, preferences, perceptions, physical and psychological responses, behaviors and accomplishments that occur before, during and after use”. The second one is related to how the user experience is perceived: “User experience is a consequence of brand image, presentation, functionality, system performance, interactive behavior

and assistive capabilities of the interactive system, the user's internal and physical state resulting from prior experience, attitudes, skills and personality, and the context of use". The third one is related to how it can be assessed: "usability, when interpreted from the perspective of the user's personal goals, can include the kind of perceptual and emotional aspects typically associated with user experience. Usability criteria can be used to assess aspects of user experience".

According to Kurosu (2019) among the three usability sub-concepts (effectiveness, efficiency and satisfaction), Nigel Bevan was most interested in the concept of satisfaction in relation to UX. The term satisfaction was first defined as "**freedom from discomfort and positive attitudes towards the use of the product**" until ISO 9241-210:2010. It was re-defined in ISO 9241-11:2018 as the "**extent to which the user's physical, cognitive and emotional responses that result from the use of a system, product or service meet the user's needs and expectations.** As this definition is very similar to the definition of UX of the same version of ISO 9241-11:2018 it appears that the editor might have thought that a stronger relation between UX and satisfaction exists.

As the experience is analyzed through the user's perspective one of the most important activities of the user-centered design is to know how to identify the user's experiences and satisfactions. There are currently several user search techniques that can be used throughout the life cycle of a project. These techniques help define groups of users that should have higher priority during the project, analyzing needs and frustrations. In the next subsections will be presented two practices: personas and scenarios.

2.4.1 Personas

Personas are archetypical representations of customers or users that provide a portable data structure that allows all members of the development team to communicate and have a common base to which to refer (BROSCHINSKY; BAKER, 2008). It is one of the different techniques that has been used in user-centered design in order to group users or costumers focusing on exploring costumers need, goals and behaviors. With appropriate research and descriptions, personas can illustrate a very clear picture of who is using the site or application and potentially even how they are using it (UNGER; CHANDLER, 2012).

Its original domain is in the marketing area, where it has been used successfully. In recent years this technique “has been investigated as a powerful design tool focused on improving the design and usability of software development through the definition of user representation after learning” (CABALLERO; MORENO; SEFFAH, 2014). Personas were introduced in the HCI community by Alan Cooper (COOPER, 1999) as part of his method Goal-Directed Design (GDD). According to him, personas represent an efficient tool to facilitate the communication and the interaction.

The HCI community has been using personas focusing on improving software design from a usability perspective and taking into account the user experience and skills (NIELSEN, 2019a). Although agile methods do not consider usability and user experience with the importance and relevance they would need, several studies point to a tendency and concern with this theme (NIELSEN, 2019b). (CHAMBERLAIN; SHARP; MAIDEN, 2006), (SY, 2007), (HAIKARA, 2007), (NAJAFI; TAYOSHIBA, 2008), (CHO, 2009) are some examples of research that explored this technique. Regarding to the phase in agile development process, personas were usually applied in two moments: in the exploratory phase, before working on any development cycle and any code was produced (WINTER; HOLT; THOMASCHEWSKI, 2012), and in the later process of coding as proposed by (CLELAND-HUANG, 2013) where each persona description has user stories with architecturally significant concerns.

According to (CABALLERO; MORENO; SEFFAH, 2014), persona is a powerful tool because it can help not only the HCI designer to build usable interfaces, but also the agile developers and the stakeholders, to elicit the client requirements and to engage them in the process.

2.4.2 Scenarios

Scenarios are stories that describe a sequence of actions and events that lead to an outcome. According to (ROSSON; CARROLL, 2002) they consist of a setting, or situation state, one or more actors with personal motivations, knowledge, and capabilities, and various tools and objects that the actors encounter and manipulate. The narrative description used of an envisioned usage can be employed in different ways and guide a system development to enable the user experience. Unlike others formal approaches exist to envisioning future possibilities, scenario-based are considered more “lightweight” and can be considered as a “sketch of use”.

They were primarily used in situating or staging test example, focusing on abstract tasks, not in a particular use. However, as usability studies explore the application of scenarios more generally in design, it changes the scenario concept from being an activity that "approves" a computer application, to an activity that takes responsibility for the product and its future use (BØDKER, 1999).

As already mentioned, the agile methods did not include guidance on how to develop usable software, and because of this some researches explored this gap and proposed solutions for this integration with the use of scenarios (LEE; STEVENS; MCCRICKARD, 2009), (OBENDORF; FINCK, 2008).

2.5 Integration of agile development and usability

During this research many studies related to the integration of agile software development and usability were found. What drew our attention was a growing number of literature reviews (including systematic literature reviews and mapping studies) on this topic. This demonstrates that, despite the numerous proposals already presented and studied, this field of research remains a relevant topic of study. Because of this, we decided to identify these studies through a tertiary study following the guidelines proposed by Kitchenham and Charters (2007). The main objective of this study was mapping the information provided by secondary studies on the integration of agile development methodologies and the concern with usability. We aimed at answering the following research questions:

1) What research questions were investigated in the secondary studies?

2) What are the main ways to integrate usability and agile software development according to the secondary studies?

3) What are the indicators of the quality of the secondary studies?

4) What challenges are described in the published studies related to the integration of usability and agile software development?

The study was conducted using four different databases: ACM, IEEExplore, ScienceDirect and SpringerLink. To define which study should be included, or not, inclusion and exclusion criteria were defined. A peer review strategy was adopted and 3065 were analyzed and at the end a total of 14 papers were then selected as a result of the classification. This study was published by (CURCIO et al., 2019) and selected

studies provided us with even more grounding and security to explore the subject. Table 2-2 describes a summary of the selected studies.

Table 2-2. Systematic reviews, literature reviews and mapping studies on integrating usability in agile software development.

Authors	Goal	Research Questions	Number of studies
Sohaib and Khan (2010)	This study is a literature review that focuses on identifying the key points of tension between usability and agile methods and also on understanding how usability-engineering practices should be integrated with agile software development in order to provide effective usable software system.	(RQ1) What tensions between usability engineering and agile methods have been identified in related research that makes them difficult to integrate? (RQ2) What approaches have been suggested in order to integrate usability and agile methods?	Not informed
Silva et al. (2011)	They conducted a systematic literature review of existing literature related to the integration of agile software development with user-centered design approaches. The goal of this study is to identify existing evidence, including practices and artifacts, regarding the integration of UCD and Agile to support a proposal of a methodology.	(RQ1) How are usability issues addressed in agile projects? (RQ2) What are common practices to address usability issues in agile methods?	58 primary studies
Barksdale and McCrickard (2012)	This study is a literature review and aims to address the interaction-related problems in agile usability teams. The authors explored how social capital and social network governance may contribute to effective management of usability knowledge in agile usability software teams. They also intended to offer some practical guidance on designing	Not explicit presented	65 primary studies

	cohesive agile usability teams.		
Wale-Kolade, Nielsen and Päivärinta (2013)	This study is a systematic literature review that aims to show how the previous studies related to integrate usability work into agile software development provides grounds, warrants, backing, rebuttal, and qualification by analyzing their claims.	(RQ1) What are the recommendations on how usability work should be executed within agile contexts? (RQ2) Are there situational factors that influence these, and what is the nature of such influences?	49 primary studies
Salvador, Nakasone and Pow-Sang (2014)	The goal of this study is to present the results of a systematic review involving the use of usability techniques in software development where agile methodologies were used.	(RQ1) Which usability methods have been applied in agile software? (RQ2) In which phases or artifacts of agile software development have usability methods been applied? (RQ3) Which kinds of evaluations have been performed when using usability methods in agile software development? (RQ4) Which empirical studies regarding usability methods have been applied in agile software development?	32 primary studies
Salah, Paige and Cairns (2014)	This study is a systematic literature review that aims to identify challenging factors that restrict the integration of Agile and User-Centered Design. During the study the authors explored some proposed practices to deal with the identified challenging factors.	(RQ1) What are the challenges that could develop during AUCDI (Agile and User Centred Design Integration) adoption process? (RQ2) What are the potential success factors for AUCDI? (RQ3) What are the potential practices for AUCDI?	71 primary studies
Jurca, Hellmann and Maurer (2014)	In this study the authors performed a systematic mapping study to identify relevant research studies related to integration of agile software engineering, user-centered design and user experience. The goal of this study was understand what the field of Agile-UX looks likes at present.	(RQ1) Is the rate of publication increasing over time? (RQ2) What venues are most important for this field? (RQ3) What types of papers are most prevalent? (RQ4) Are the types of studies changing over time? (RQ5) What are the recommendations of existing work?	76 primary studies
Zapata (2015)	In this study the author developed a systematic literature review to answer how agile methodologies and techniques of usability have been integrated during the	(RQ1) What usability methods are integrated into software development methodologies? (RQ2) What agile methodologies have integrated usability techniques throughout the complete software development process?	37 primary studies

	various stages of software development.	(RQ3) What new frameworks or methods have been proposed for the integration of agile processes and usability engineering?	
Brhel et al. (2015)	In this study the authors developed a systematic review focused in capture the current state of the art in user-centered agile software development (UCASD) approaches. The goal of this study was to investigate these approaches and to derive generic principles from them.	(RQ1) Which principles constitute a user-centered agile software development approach?	83 primary studies
Silva et al. (2015)	In this study the authors present a systematic mapping of agile user-centered design publications at the major agile and human-computer interaction (HCI) conferences. The goal of this study was to present a summary of the Agile UCD field and to find out the topics this field encompasses	(RQ1) What is agile UCD? (RQ2) What types of HCI techniques have been used to integrate agile and UCD? (RQ3) What types of studies on agile UCD have been published? (RQ4) What types of research methods have been used in agile UCD studies? (RQ5) What benefits do these publications offer? (RQ6) Who are the major authors in this field? (RQ7) Is this field driven by academics, practitioners or collaborations?	46 primary studies
Dhandapani (2015)	This study intends to review some of the existing literature aiming to find out some common observations and differences recorded regarding the integration of user centered design and agile approach.	(RQ1) Is the integration of UCD and agile possible? (RQ2) Is the team of UI designer and developer able to successfully integrate and deliver the product? (RQ3) Will the team repeat the model they found?	Not informed
Magües et al. (2016a)	In this study the authors conducted a systematic mapping study to investigate the integration of the agile software development and user-centered design according four criteria: processes, practices, team and technology.	(RQ1) What is the current state of the integration of agile processes and usability?	161 primary studies
Magües et al. (2016b)	In this study the authors conducted a systematic mapping study to investigate the integration of the agile software	(RQ1) What is the current state of the integration of agile processes and usability techniques?	31 primary studies

	development and user-centered design throughout usability techniques.		
Bertholdo, Kon and Gerosa (2016)	In this study a literature review was conducted to identify patterns of use of agile usability practices focusing on the user centered design final stages.	(RQ1) What are the agile usability practices related to the final stages of UCD used?	Not explicit presented
Garcia, Silva and Silveira (2017)	In this study a systematic mapping study on artifacts and their role in communication between agile and user-centered design fields was conducted.	(RQ1) Which are the artifacts that facilitate communication between Agile Methods and User-Centered Design areas? (RQ2) Which event of the process are these artifacts being used? (RQ3) Are these artifacts physical or electronic?	56 primary studies

From the secondary studies already identified, the selection of the primary studies was started, so that it was possible to analyze how these proposals addressed the integration of usability and user experience to the agile software development.

The first attempts to integrate usability and agile software development were proposed approximately a decade ago, through user-centered design approach. Some works as (MILLER, 2005), (SY, 2007), (FOX; SILLITO; MAURER, 2008), (FERREIRA; SHARP; ROBINSON, 2010) and (SILVA et al., 2011), proposed very similar solutions. In (SILVA et al., 2011) their proposal was based on Scrum framework with multidisciplinary teams, including developers and user-centered design specialists (UCDS), but working in separate (parallel) tracks. The UCDSs teams should work according to the concept of “one *cycle ahead*” proposed by Sy (2007), preparing the material to deliver to the development team as demonstrated in Figure 2-6.

Although this model was already established, many studies focused on studying the points of tension between the integration of these two areas. In the work proposed by (SALAH; PAIGE; CAIRNS, 2014) some of these points are explored, such as: lack of time for upfront activities, difficulty of prioritizing UCD activities, difficulties on performing usability tests, workload of UCD practitioners and lack of documentation. Another work that explored some points of tension was the one proposed by (SOHAIB; KHAN, 2010).

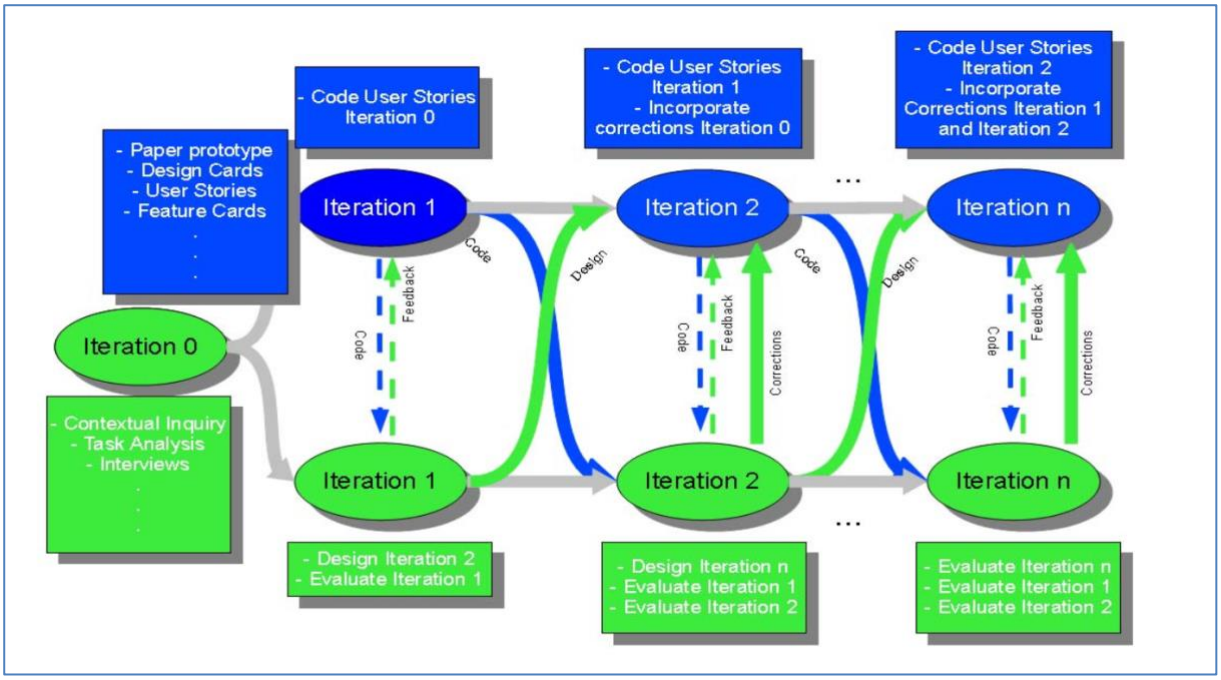

Figure 2-6. Framework proposed by (SILVA et al., 2011) to integrate UCD and agile development.

Recently another approach called BoB (*Best of Both Worlds*) proposed by Kuusinen (2016) was presented as an alternative to the commonly recommended iteration-ahead approach for integrating UX work in agile development. The idea of this framework is to combine the advantages from UCD and the agile development that are normally considered to be mutual exclusive. The UX design and even some lightweight user studies are conducted together with development activities in the same iteration, as demonstrated in Figure 2-7. The idea is to use the same cycle throughout the project and it mitigates the concept of separate upfront design phases. Instead of having a particular upfront design phase, this framework included the design and planning work into several “normal” iterations containing both UX design and development tasks.

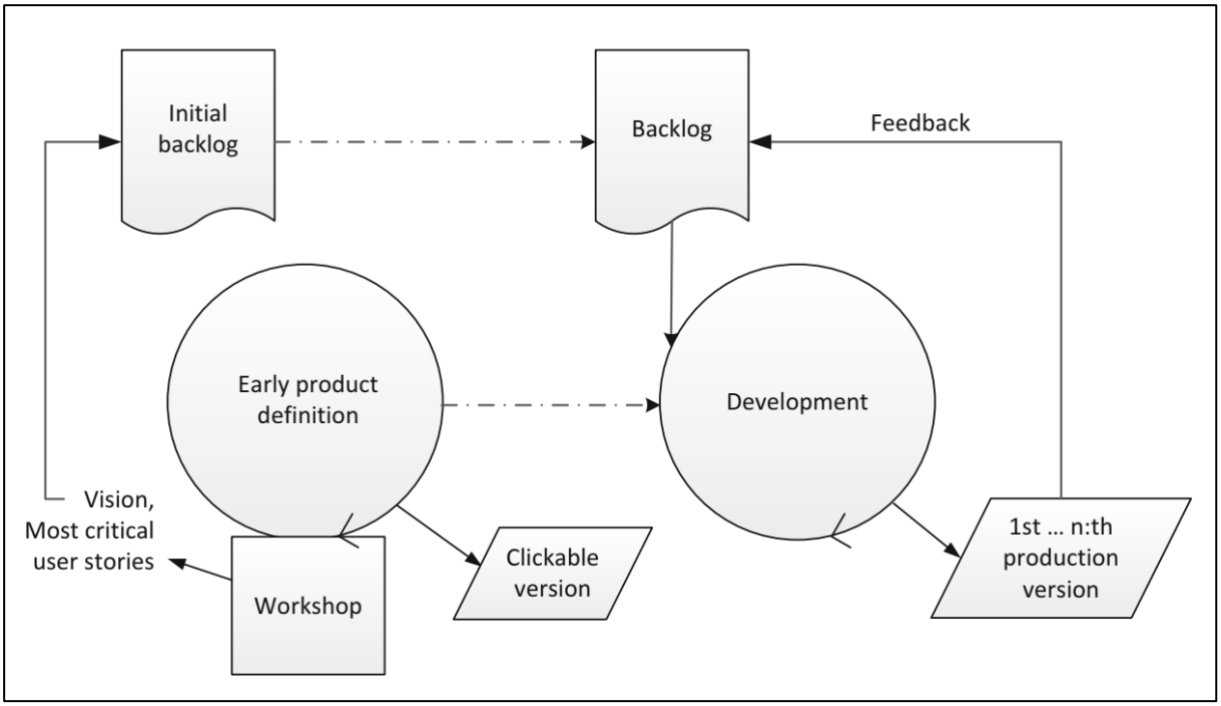

Figure 2-7. Framework BoB proposed by (KUUSINEN, 2016) to integrate UCD and agile development.

Another approach, similar with "*one cycle ahead*", called "*dual track Scrum*" (PATTON, 2017) proposes separate tracks, one called "discovery" for product discovery and another called "delivery" for implementation. These activities are developed in different parts but by just one process. The whole team is responsible for products outcomes. According to Cagan (2012) the discovery track is all about quickly generating validated backlog items and the delivery track is responsible for generating releasable software. We could identify no research articles on "*dual track Scrum*" approach, thus it was not possible to present or discuss about its advantages or disadvantages.

The Lean UX (GOTHELF; SEIDEN, 2013) is another approach for an extremely fast user-centered software development that was recently adopted especially by startups to create radically new products. This approach has three main influences: the Design Thinking movement (BROWN, 2008), Lean Startup Method (RIES, 2011) and Agile Software Development (AGILE MANIFESTO, 2001). After the publication of Gothelf and Seiden (2013) book, the community created the Lean UX Manifesto (VIVIANO, 2014) with the same spirit of the Agile Manifesto. It describes six principles that describe the Lean UX way of working:

1. **Early customer validation** vs. releasing products with unknown end-user value.
2. **Collaborative cross-functional design** vs. lonely hero design.
3. **Solving user problems** vs. adding cool features.
4. **Measuring key performance indicators** vs. undefined success metrics.
5. **Applying appropriate tools flexibly** vs. following a rigid methodology.
6. **Nimble design** vs. heavy wireframes or specifications.

The Lean UX process, as represented in Figure 2-8, considers the design and user involvement inside sprints. The sprints include setting hypotheses, developing a MVP, testing with users and learn from feedback to improve the design. The sprints usually take 2 weeks and at the end of each week the users test the solution. All feedbacks are taken to improve the product. So instead of having just one big user test, there will be several small user tests, focusing the new feature that is being created. This requires the prioritization of the most important features to be tested and validated by the users as soon as possible.

Besides user testing, users are represented by hypothetical personas (proto personas) to be validated through interactions with people participating in the tests. User stories are also used to describe systems functionalities and refer to personas who desire to achieve a specific goal.

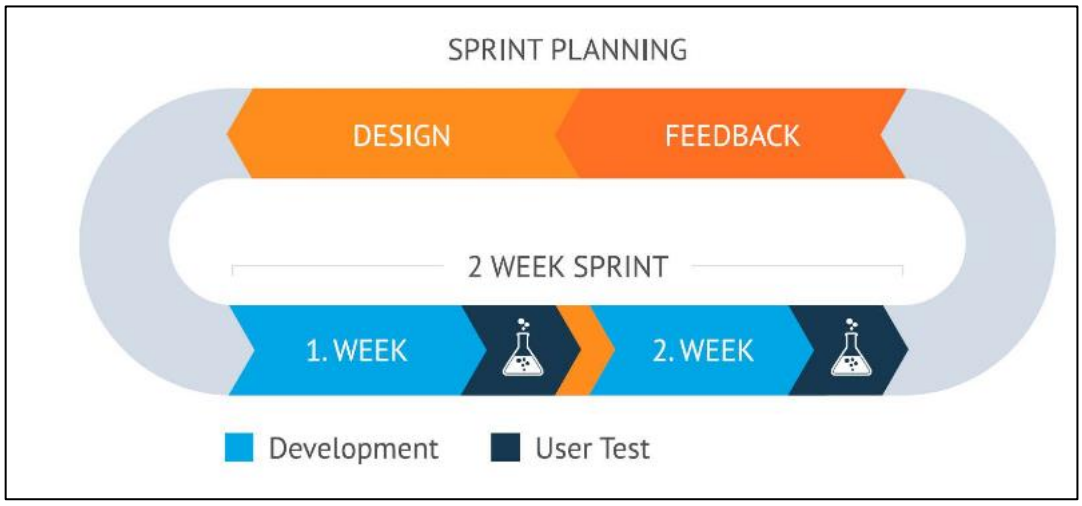

Figure 2-8. Lean UX process representation (LIIKKANEN, 2014).

Table 2-3 presents a comparison between the three main approaches found.

Table 2-3. Different approaches to integrate UX to agile software development.

	Process	**Practices / Task**	**Team / People**	**Technology / Tools**	**Artifacts**
Iteration-ahead approach	UX designer and developers are always working in separate tracks. UX designers are always one iteration ahead of the developers.	Integrate UX work through different roles and tracks.	Separate tracks (designers and developers) with specific knowledge.	X	Prototypes
Within-iteration approach	Developers work within one iteration.	Integrate UX work via tasks not via roles.	Learn from others: Broaden your competence areas.	Communicate UX tasks via backlog.	Navigable Prototypes
Dual Track Scrum	Separate product discovery and implementation into separate tracks. But they represent only one process.	Integrate UX work through different roles and tracks.	Product Owner/ manager, lead developer, UX/UI are constantly involved in discovery and delivery tracks.	X	Personas, User stories and Prototypes
Lean UX	UX designers and developers work together during the sprints.	Integrate UX work through different roles and practices through the application of Design Thinking, Lean Startup and Agile Software development approaches.	UX designers and developers work together during the sprints with user involvement to validate the MVP.	X	Proto Personas and user stories

During the development of the systematic review of this research two process created by industry and currently being disseminated by the startup's community were identified, however no published paper with results of their application has been found. These two processes combine the agility and the participation of UX designers to solve problems and validate ideas before starting a product development. The first one is called "Design Sprint" and the second one is called "Lean Inception". Design Sprint is a five-day process that uses the concepts of Design Thinking (BROWN, 2008) with the aim of reducing the risk when bringing a new product, service or a feature to the market. It has been developed through independent works developed by designers including those within Google Ventures and Boston-Based User Experience Agency (Fresh Tilled Soil). Some results of those works can be found on two published books: one published by Knapp, Zeratsky and Kowitz (2016) and another by Banfield, Lombardo and Wax (2015). The process aims to help teams to clearly define goals, validating assumptions and deciding on a product roadmap before starting the development. As demonstrated in Figure 2-9 the process is composed of five days and specific goals are set for each day.

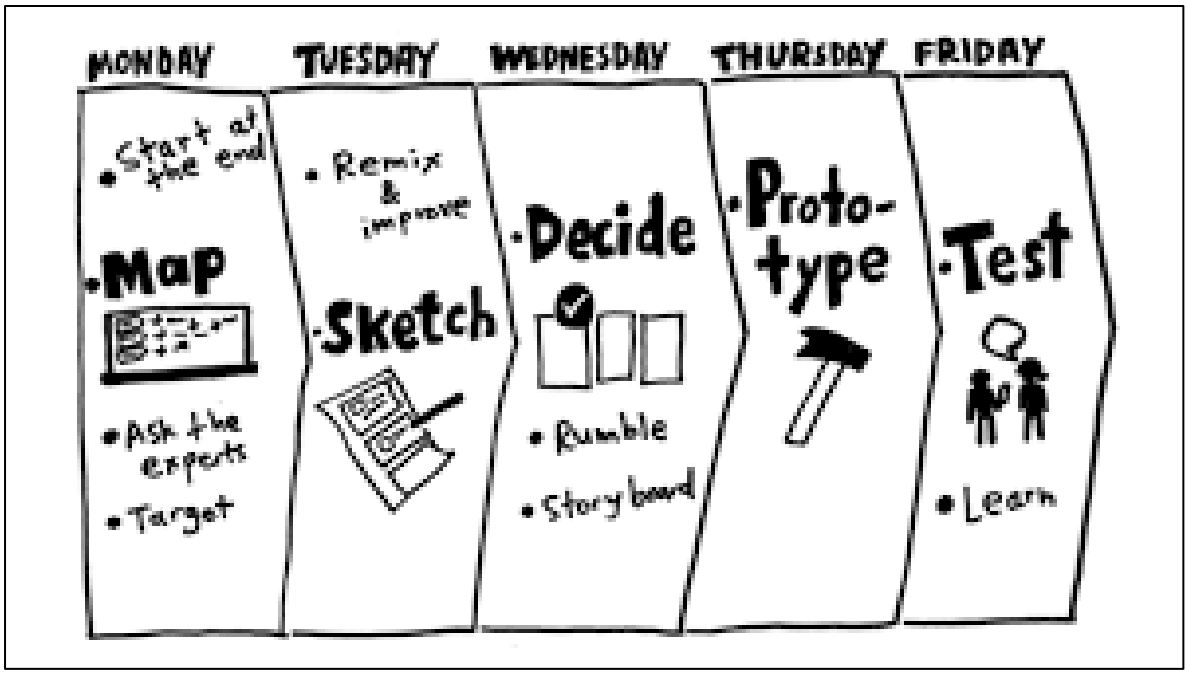

Figure 2-9. Representation of Design Sprint process (KNAPP; ZERATSKY; KOWITZ, 2016).

On Monday it's necessary to understand the objectives and map the business. On Tuesday it is necessary to outline the different ideas that are coming up so that soon afterwards on Wednesday the team must decide between the various ideas, which one will be taken as a solution. On Thursday, prototypes of this solution will be created so that on Friday it can be tested with real users. This process avoids spending on developing projects that have not been minimally validated.

The second process identified, called Lean Inception, can be described as "a recipe, a sequence of collaborative and dynamic activities that will help to build the MVP canvas" (CAROLI, 2018). It is a visual representation of the lean product's evolution and creation plan as demonstrated in Figure 2-10. During the inception a good sample of the people who will be affected by the product are put together to discuss and set directions through collaborative exercises. The idea behind this is to understand what are the features and outcomes to assess the effectiveness of the product to be developed. It is not expected to have at the final of the process a released product with all required user's features but instead a minimum viable product canvas that can be used to learn from and generate new release (Build- Measure- Learn).

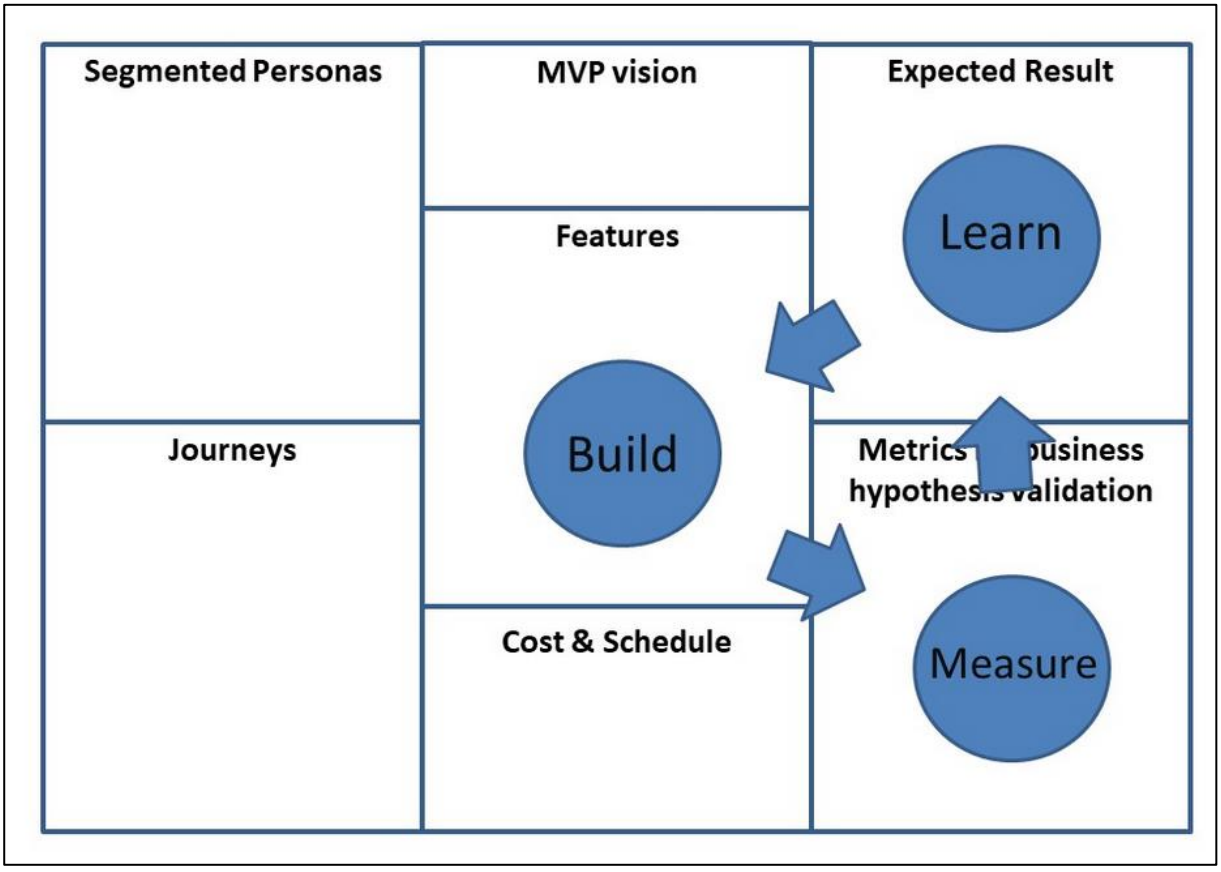

Figure 2-10. MVP Canvas (CAROLI, 2018).

From the analysis of the previous proposals, we were able to identify several aspects considered to be flawed regarding the integration of usability and user experience in agile development, which are described below:

- None of the previous proposals aimed at anticipating the potential problems or pain points of end users, even for the initial phases of requirements gathering, resulting in useful products but not usable.
- None of them addresses in detail a proposal to document the most critical requirements that involve users' feelings in order to have a better user experience.
- The use of only prototypes for the requirements analysis and validation can also make the maintenance of the systems difficult sometimes, precisely because of the lack of documentation of the projects (SALAH; PAIGE; CAIRNS, 2014).
- Lack of documentation can also lead to misunderstanding of requirements in regard to UX deliverables (BUDWIG; JEONG; KELKAR, 2009).
- None of the previous proposals provide guides or compasses for conducting tests, leading to non-execution of tests, including the critical points of the system or even usability itself.
- Some of the proposals provide different roles during software development to highlight activities directly related to end-user experience, but not all of them deal with the balance of activities as a critical aspect. This often results in a power struggle that weakens the team and affects the quality of the work (SALAH; PAIGE; CAIRNS, 2014).

2.6 Considerations about this chapter

In this chapter the main topics needed to understand this research project were explained. We also presented the studies related to the literature review of the integration of usability in agile development, as well as we tried to highlight the differences between the main previously proposals. It was therefore tried to emphasize the importance and the need to deepen research in terms of practices, roles and

artifacts to improve the communication and integration between agile development and usability, focusing on a better result in the final user experience.

After describing the fundamental concepts for the understanding of the research, it is necessary to present the methods applied for the development of this research, which will be described in the next chapter.

CHAPTER 3 - RESEARCH APPROACH

This chapter describes the research structure conducted about the understanding of how usability and user experience are integrated into agile software development, as well as the methods adopted to conduct and evaluate this research.

Before beginning the process of detailed description of the phases of this research, the characterization of the research will be presented. According to (COLLIS; HUSSEY, 2009), a research can be classified according their purpose in: exploratory, descriptive or evaluation research. In an article published by (WOHLIN; AURUM, 2015) exploratory research is applied when there is not much information available in the topic area and the research aims to gather some insights about the problem. The aim is to explore the problem area and provide background information for further research. Exploratory research can be both qualitative and quantitative research.

Considering the research objectives described in Chapter 1, we can characterize this as an **exploratory research** since it aims to identify **how to integrate usability with agile software development focusing on user experience.** To accomplish this goal the research was separated into four different phases as described in Figure 3-1. Next sessions present the details of each phase proposed in this work.

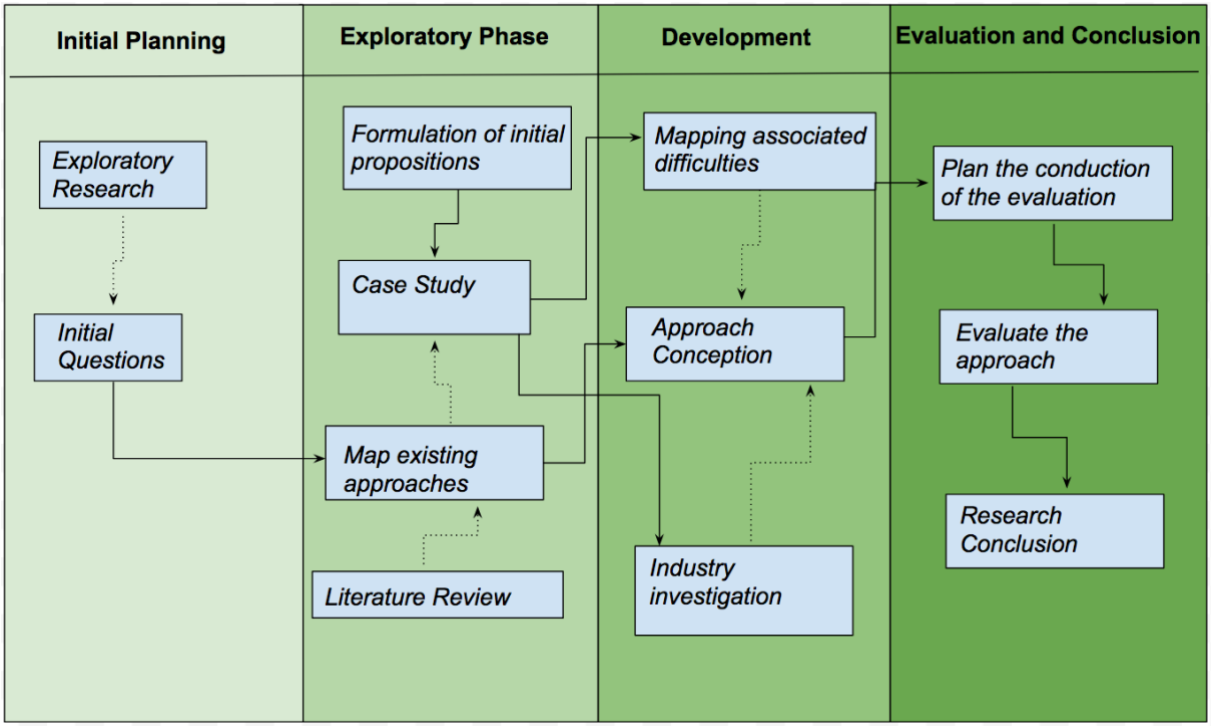

Figure 3-1. Research strategy.

3.1 Initial Planning

To start this research, we performed a preliminary exploratory study in the field of requirements engineering in agile environments, which resulted in a systematic mapping study of this area. In the elaboration of this research Kitchenham and Charters (2007) research protocol was used, and the results were published in (CURCIO et al., 2018). After completing this study, a need was identified to deepen knowledge in the area of quality. Agile development methods are sometimes criticized for not having explicit practices for non-functional requirements. This negative tendency of neglecting quality requirements probably emerged due to the fact that in agile methods the use of minimum documentation is intrinsic. This brings the erroneous impression that quality is not necessary or can be treated in background. As reported in the previous chapter, the large number of reviews and mappings in the area of usability and agile development drew our attention. For this reason, a tertiary study was developed so that we could, from the studies identified, further explore this topic.

With the definition of the area of interest, initial questions to guide the research were defined: **How usability and user experience are being handled by agile methodologies? - Is there a concern of the development team in addressing this**

topic and improving the user experience in the final product? - What roles and artifacts are involved?

However, the initial questions of the research provided only an initial orientation, since the research area is quite broad. This established the field of study that should be investigated. Thus, for the continuity of the research it is necessary to explore the field of study, going to the next phase, exploratory.

3.2 Exploratory Phase

This section aims to present the methodological approach applied to the development of the exploratory phase of this research project. In this phase two activities were developed in parallel: the literature review, already presented in the previous chapter and multiple case studies. The method selected to develop the case studies was proposed by (YIN, 2009), which was fully applied in the elaboration from the early stages. The representation of the activity flow is shown in Figure 3-2.

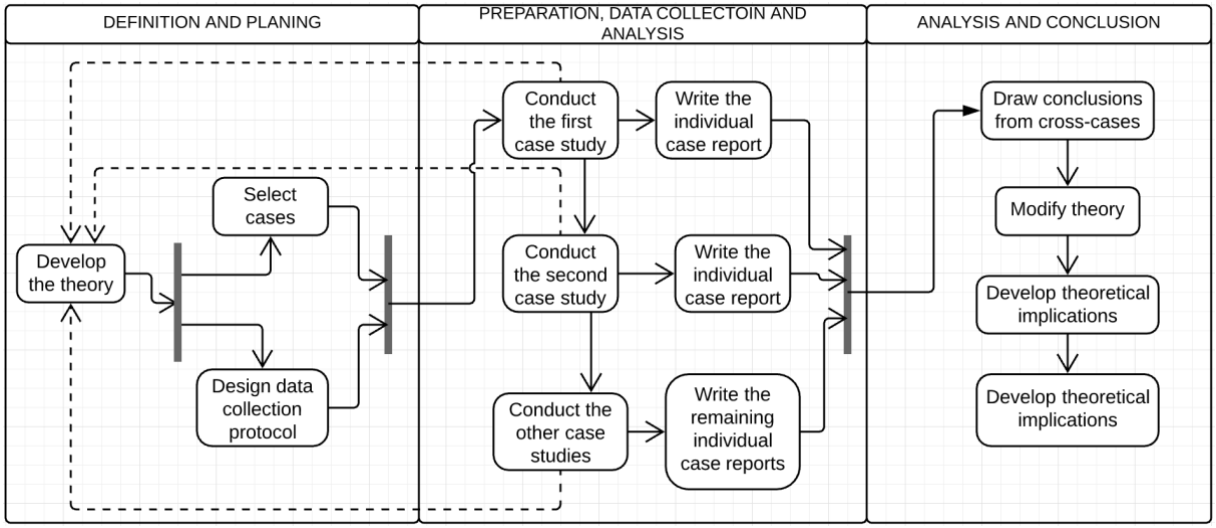

Figure 3-2. Multi-case study process, adapted from (YIN, 2009).

In general, case studies represent the preferred strategy when questions such as "how" and "why" are posed, when the researcher has little control over the events and when the focus is on contemporaries' phenomena inserted in some context of real life. According to Eisenhardt (1989) the case study is a research strategy which focuses on understanding the dynamics present within single settings. Case studies can be used to accomplish various aims: to provide description, test theory, or generate theory.

Some of the components usually present in conducting research using this method, according to (YIN, 2009), are: **study questions, propositions, units of analysis, logic that joins data to propositions and, finally, criteria for interpretations and findings**. These components are presented in the following sections.

3.2.1 Structure and components

The components of the research structure are based on the same structure proposed by (REINHER, 2008) and will be presented in the following sections with a brief explanation of their scope or purpose:

- **Primordial research question** - it guides research in a general way and comprises questions such as "how?" and "why? ".
- **Propositions** - direct the attention of the researcher to what will be examined in the scope of the case study.
- **Units of analysis** - they are represented by an individual, some event or entity (decisions, programs, deployment and change processes) or an organization (or part). In the case of this project, the units of analysis are represented by the target organizations of the case studies.
- **Research protocol** - represents the basic structure of the research, especially considering (i) operational procedures, research overview, non-disclose agreement (NDA), cover letter and (ii) case report model.
- **Research script** - represents the composition of the operational procedures with the set of analysis points.
- **Analysis points** - present themes to be explored in the investigation and analyzed, contemplating the questions to support the interviews and the mapping of related propositions.

3.2.2 Research question and Propositions

The primordial questions that this research seeks to address, as part of the main objective presented previously are:

1) **How usability is being integrated to agile software development?**
2) **What are the difficulties associated with this integration?**

In order to answer the primordial research questions, the propositions were elaborated, based on issues taken from the literature, aiming at unfolding the aspects that will be explored in the case studies. Propositions related to how usability is being integrated to agile software development are presented in the sequence:

P1 - Software development companies use the user-centered design approach combined with agile software development to address the usability of projects.

P2 - There are software development companies in which the integration of usability to agile development is accomplished through the incorporation of usability specialists to the team without necessarily having specific practices defined in the development process.

P3- There are software development companies where the integration of usability into agile software development is accomplished through the use of technologies and / or tools.

P4- There are software development companies where the integration of usability into agile software development is associated with a specific type of development platform (web, mobile, etc.).

Propositions related to the difficulties associated to this integration:

P5- The lack of knowledge and/or expertise in the area of usability is one of the main reasons that make it difficult to handle usability in agile software development.

P6- The difficulty of usability integration in agile software development is associated with the lack of support from top management.

P7- The need to deliver value to customers in a short time is one of the main factors that lead companies not to apply usability practices in agile software development.

P8- The difficulty of usability integration in agile software development using a user-centered approach is associated with the large difference between the principles involved in each of these approaches.

3.2.3 Units of analysis

The criteria for selecting the organizations to participate in the case studies are presented by the following characteristics:

- It is a software development company in Brazil that uses agile methodologies for the development;
- Regardless of whether subcontracting is used in the production process, the organization or area must exercise control over the entire software development lifecycle.

3.2.4 Research Protocol

3.2.4.1 Operational routine

The operational procedure used to conduct this study was initiated with prior contact with the organizations selected from the contacts network of the supervisors as well as the colleagues of the research group. Then, we analyzed the available information to verify if they fit the research to be developed. More detailed information about the purpose of the survey, the research scope overview, was sent by e-mail, so that the organization could understand which skills would be needed to conduct the case study through semi-structured interviews. The research questions for the development of the semi-structured interviews are presented in APPENDIX A. Along with this document two other documents were also sent: the cover letter and the non-disclosure agreement. The research overview document is presented in APPENDIX B. The cover letter is issued by the research project supervisor, aiming at formalizing and facilitating the researcher's access within organizations. This document is presented in APPENDIX C. The non-disclosure agreement is also issued by the research project supervisor and includes all those involved in the research, including students and co-supervisors. This document is presented in APPENDIX D.

After these steps the meetings were planned and scheduled. All interviews were recorded, with the consent of the interviewees for further analysis. For the interviews that could not be done on site, videoconferences tools were used so that they could also be recorded.

After conducting the interviews, all data were analyzed and consolidated considering the individual scope of each organization. Finally, a consolidated evaluation of all cases was carried out considering the propositions and their respective theoretical references.

3.2.5 Concepts supporting the propositions analysis

In this section, the main literature references to support each of the propositions are related.

P1 - Software development companies use the user-centered design approach combined with agile software development to address the usability of projects.

The following concepts of support were used as a basis to characterize the analysis of proposition P1, which addresses the use of the user-centered approach to integrate usability with agile software development.

i. Manifesto for agile development (AGILE MANIFESTO, 2001).
ii. Main methodologies/agile frameworks (SCHWABER; SUTHERLAND, 2017), (BECK; ANDRES, 2004) e (COCKBURN, 2004).
iii. Concepts of user-centered design approach or human-centred design (ISO 9241-210, 2010).
iv. Usability concepts (ISO 9241-11, 1998)
v. Concepts about systems and software quality (ISO/IEC 9126, 2001) and (ISO/IEC 25000, 2014).

The first aspect taken into consideration was related to the Agile Manifesto. Starting from this meeting, which brought together seventeen people in Utah, they have set out twelve principles that guided this “Manifesto for Agile Software Development. Since then various agile methodologies and frameworks have been gaining market space as XP (BECK; ANDRES, 2004), Scrum (SCHWABER; SUTHERLAND, 2017) and Crystal Clear (COCKBURN, 2004).

The third aspect taken into consideration was the concept of user-centered design approach (ISO 9241-210, 2010). It is a set of techniques, procedures and process as well philosophy that places the user at the centre of the development process. Users are involved in every step of the project that provides a valuable source

of knowledge about the usage context, tasks, and how users are likely to work with the future product, system, or service.

The fourth aspect is the concept of usability according to the (ISO 9241-11, 1998) that defines it as "**extent to which a system, product or service can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use**". This international standard is related to ergonomic requirements.

On the other hand, we have the (ISO/IEC 9126, 2001) and (ISO/IEC 25000, 2014) series standards that are related to software quality and point the usability as a non-functional characteristic of software quality. The meeting point between standards of ergonomics and software quality lies in the definition of quality in use which is defined as **"degree to which a product or system can be used by specific users to meet their needs to achieve specific goals with effectiveness, efficiency, freedom from risk and satisfaction in specific context of use"**. The quality in use model defines five characteristics related to outcomes of interaction with a system and are represented by: effectiveness, efficiency, satisfaction, freedom from risk and context coverage.

In order to evaluate this proposition, we attempted to identify the presence of agile frameworks or methodologies within organizations that demonstrate the use of the user-centered approach together with focusing on the usability of the projects.

P2 - There are software development companies in which the integration of usability to agile development is accomplished through the incorporation of usability specialists to the team without necessarily having specific practices defined in the development process.

The following concepts of support were used as a basis to characterize the analysis of proposition P2, which deals with the incorporation of usability specialists to the agile development team.

i. The concept of multidisciplinary team in agile software development (SCHWABER; SUTHERLAND, 2017).
ii. Importance of the incorporation of professionals responsible for the definition of design and usability of interfaces. (MCINERNEY; MAURER, 2005),

(SILVA et al., 2013) AND (LARUSDOTTIR; GULLIKSEN; CAJANDER, 2016).

iii. Different ways to integrate usability with agile software development (MAGÜES; CATRO; ACUÑA, 2016a).

The first aspect taken into consideration was the concept of multidisciplinary team building in agile development. According to the Scrum Guide (SCHWABER; SUTHERLAND, 2017), scrum teams are self-organizing and multifunctional. Within this concept come roles such as: developers, testers, architects and designers. When we refer to usability experts, these can take different names in the market and are currently known by user research, user experience engineer, interaction designer, interface designer or usability practitioner (UXPA, 2018), (BRUUN et al., 2018). We understand that all these roles can develop activities that promote the improvement of the quality of the final product mainly in terms of usability.

The second aspect is the importance of the incorporation of professionals responsible for the definition of design and usability of interfaces. The importance of this role in agile team is discussed in (MCINERNEY; MAURER, 2005). Another study that discussed the importance of user experience professionals and the need to include an explicit role in agile projects was presented in (LARUSDOTTIR; GULLIKSEN; CAJANDER, 2016) and (SILVA et al., 2013).

The third aspect is the discussion about the different ways available today to integrate usability to agile software development. (MAGÜES; CASTRO; ACUÑA, 2016a) presented the current state of integration between agile processes and usability through a Venn diagram. The possibilities of this integration were represented by the relation through the subsets of: processes, technologies, practices and teams. The subset teams represent the changes in the composition of team to include experts from both disciplines and reflect the social interaction between professionals to build a body of knowledge. This gave us indications to start this investigation.

P3- There are software development companies where the integration of usability into agile software development is accomplished through the use of technologies and / or tools.

The following concepts of support were used as a basis to characterize the analysis of proposition P3, which deals with the integration of usability into agile software development through the use of technologies and / or tools.

i. Different ways to integrate usability with agile software development. (MAGÜES; CATRO; ACUÑA, 2016a).
ii. Support tools for integrating usability into agile development. (HUMAYOUN; DUBINSKI; CATARCI, 2011), (SHANKAR et al., 2015), e (GONÇALVES; SANTOS, 2011).

As already mentioned, (MAGÜES; CASTRO; ACUÑA, 2016a) presented the current state of integration between agile processes and usability through a Venn diagram. For this proposition our focus is to analyze the subset represented by technologies. An example of this integration was presented in some studies as described in (HUMAYOUN; DUBINSKI; CATARCI, 2011) e (GONÇALVES; SANTOS, 2011). The first one presented a framework that incorporates user-centered design (UCD) philosophy into agile software development through a three-fold integration approach: at the process life-cycle, at the iteration level and at development-environment level for managing and automating the sets of UCD activities through automated tools support. The second one proposed a tool that is able to build low-fidelity prototypes, document them and support user testing, facilitating the process of creating interfaces when using the scrum methodology.

In order to evaluate this proposition, we attempted to identify the presence of technologies or tools, which help the process of integrating the agile development process and the user-centered approach with a focus on usability analysis.

P4- There are software development companies where the integration of usability into agile software development is associated with a specific type of development platform (web, mobile, etc.).

The following concepts of support were used as a basis to characterize the analysis of proposition P4, which intends to investigate whether the integration of usability into agile development is associated with some kind of development platform.

i. General usability guidelines (NIELSEN, 1993) and (SHNEIDERMAN, 2005).

ii. Concepts about software product quality (ISO/IEC 9126, 2001) e (ISO/IEC 25000, 2014).
iii. Specific usability guides for smartphones (AHMAD; REXTIN; KULSOOM, 2017).

The first aspect taken into consideration was the knowledge about general usability guides, heuristics (NIELSEN, 1993) and (SHNEIDERMAN, 2005) and especially how usability affects the quality of the final product (ISO/IEC 9126, 2001) e (ISO/IEC 25000, 2014).

In some studies we found proposals where specific usability guides where developed to work with smartphones, as demonstrated in (AHMAD; REXTIN; KULSOOM, 2017);

The idea of this proposition is to investigate whether any specific platform, for example the mobile, forces the organization to produce more specific processes or artifacts to treat usability in agile development.

P5- The lack of knowledge and/or expertise in the area of usability is one of the main reasons that make it difficult to handle usability in agile software development.

The following concepts of support were used as a basis to characterize the analysis of proposition P5, which deals with difficulties to handle usability in agile software development. The objective is to investigate whether the lack of knowledge or expertise is one of these main difficulties.

i. Concepts of usability (ISO 9241-11, 1998).
ii. Concepts of user experience (ISO 9241-210, 2010).
iii. Concepts about software product quality (ISO/IEC 9126, 2001) e (ISO/IEC 25000, 2014).

The first aspect taken into consideration was related to the mains concepts of usability, including (efficiency, effectiveness, satisfaction). To investigate this proposition not only the concepts of usability should be clear but also the concepts related to user experience and software quality (including non-functional requirements) (ISO/IEC 9126, 2001) e (ISO/IEC 25000, 2014) and if they are somehow disseminated in the organization.

P6- The difficulty of usability integration in agile software development is associated with the lack of support from top management.

The following concepts of support were used as a basis to characterize the analysis of proposition P6, which also deals with difficulties to handle usability in agile software development.

i. Challenges encountered by the industry in integrating agile development into user-centered (SALAH; PAIGE; CAIRNS, 2014).

In order to evaluate this proposition, we take the study of (SALAH; PAIGE; CAIRNS, 2014). In this study participants reported the lack of management support to UCD efforts. This was attributed to a variety of reasons including lack of management awareness of UCD impact on the overall quality of the product, lack of awareness on the importance of UCD practitioner role, tight schedules, and lack of funds. The goal of this proposition is to investigate if the difficulty of integration is associated with the lack of support from top management.

P7- The need to deliver value to customers in a short time is one of the main factors that lead companies not to apply usability practices in agile software development.

The following concepts of support were used as a basis to characterize the analysis of proposition P7, which deals with factors that lead companies not to apply usability practices in agile software development. The goal is to investigate if the need to deliver value to customers in a short time is one of the main factors.

i. Main concepts of framework Scrum especially sprint (SCHWABER; SUTHERLAND, 2017).
ii. Usability practices (SILVA et al., 2011).
iii. Usability Evaluation Practices (SILVA; SILVEIRA; MAURER, 2015).

The first aspect taken into consideration was related to the mains concepts of the framework Scrum. As described in the Scrum Guide (SCHWABER; SUTHERLAND, 2017) it consists in teams associated to papers, events, artifacts and rules. One of the main concepts of the Scrum is related to sprints. Sprint is a time-

boxed of one-month or less, during which a potentially usable incremental version of the product is created. A new sprint starts immediately after the previous sprint finishes. The idea is to deliver value to the customer, in the form of usable product, as soon as possible.

It is already known by the community that to apply usability practices (SILVA; MARTIN; MAURER; SILVEIRA, 2011) or evaluations in agile software development takes time and effort. This is discussed in the study presented by (SILVA; SILVEIRA; MAURER, 2015). This may be one of the reasons that would lead to non-use of usability practices.

P8- The difficulty of usability integration in agile software development using a user-centered approach is associated with the large difference between the principles involved in each of these approaches.

The following concepts of support were used as a basis to characterize the analysis of proposition P8, which deals with the difficulties associated to the integration of agile software development using a user-centered approach.

i. Principles of Agile Development (AGILE MANIFESTO, 2001).
ii. Principle involved in user-centered design (ISO 9241-210, 2010).
iii. Concepts about tests involving users (ISO 9241-210, 2010).
iv. Differences in concept about users and customers (ISO 9241-210, 2010).
v. Identify the tensions point between usability and agile methods (SOHAIB; KHAN, 2010).

The goal of this proposition is to investigate whether the difficulty of usability integration between agile and user-centered design is associated with the large difference between the principles involved in each of these approaches. The agile principles described in Agile Manifesto (AGILE MANIFESTO, 2001) are:

1. Our highest priority is to satisfy the customer through early and continuous delivery of valuable software.
2. Welcome changing requirements, even late in development. Agile processes harness change for the customer's competitive advantage.
3. Deliver working software frequently, from a couple of weeks to a couple of months, with a preference to the shorter timescale.

4. Business people and developers must work together daily throughout the project.
5. Build projects around motivated individuals. Give them the environment and support they need and trust them to get the job done.
6. The most efficient and effective method of conveying information to and within a development team is face-to-face conversation.
7. Working software is the primary measure of progress.
8. Agile processes promote sustainable development. The sponsors, developers, and users should be able to maintain a constant pace indefinitely.
9. Continuous attention to technical excellence and good design enhances agility.
10. Simplicity--the art of maximizing the amount of work not done--is essential.
11. The best architectures, requirements, and designs emerge from self-organizing teams.
12. At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behavior accordingly.

On the other hand, the principles described in the user-centered approach, as described by ISO 9241-210:2010, are:

1. The project is based on an explicit understanding of users, tasks and environments.
2. Users are involved in all the design and development.
3. The project is driven and refined by a user-centered assessment.
4. The process is iterative.
5. The project addresses the user experience as a whole.
6. The project team includes multidisciplinary skills and perspectives.

The two first aspects taken into consideration was related to agile and UCD principles. One of the agile principles is to “deliver working software frequently, from a couple of weeks to a couple of months, with a preference to the shorter timescale”. The consequences of this principle when analyzed under UCD lenses are:

1) Lack of time to perform upfront activities that are related to user-centered design.

2) In the vast majority of projects only functional test are performed. Usability test are placed in the background and often are not performed. In UCD approach the test with the final users are considered essentials (ISO 9241-210, 2010).

The third aspect taken into consideration is the differences between the concepts of users and customers. Another agile principle is “Our highest priority is to satisfy the customer through early and continuous delivery of valuable software”. This principle conflicts with the interests of the user-centered approach where the “users are involved in all the design and development”.

All these conflicting principles are discussed in the study presented by (SOHAIB; KHAN, 2010) and are pointed out as “tensions points” related to the integration of agile development and usability.

3.2.6 Analysis Points

After defining the theoretical concepts that would be used to evaluate the propositions, we proceeded to define the analysis points. For this the following format presented in Table 3-1 was defined:

Table 3-1. Template of analysis points description.

ANALYSIS POINTS	
AP-n – Description of the analysis points.	
Detailed description of the analysis points to support the interview.	**Pn** Related Proposition

The analysis points are presented in the sequence and are composed of the questions to guide the interview. The objective of the analysis points is to consolidate all the issues that a certain point can contemplate, so that during the interview, there is no forgetting of some important topic, leading to the need of a new intervention with the organization.

Table 3-2. Analysis points description.

ANALYSIS POINTS	
AP-01 – Usability specialists in the composition of agile development teams.	
1) Is there any initiative of the organization for the allocation of specialist's resources in usability in the composition of agile development teams? 2) How are specialists involved in software development projects? 3) Do the specialists work in the same software product development teams or are they allocated separately on demand?	P2, P5
AP-02 – Tools that help usability integration to software product development.	
1) Is there any tool used by the development team that helps usability integration to software product development? 2) What are they and in what phase of the project are they used? 3) How do these tools help the development of the software product?	P3
AP-03 – Focus of the integration of usability and agile software development for a specific type of development platform.	
1) Does the organization develop software for a variety of platforms? Which are they? 2) Do the established development processes fit all platforms? 3) Is there a platform on which the organization understands that it is necessary to work strongly on the usability of the project? Why?	P4
AP-04 – Practices and/or processes that combine the user-centered design approach with the agile software development, demonstrating the integration of usability to agile software development.	
1) Does the organization have any established process for software development? 2) Are there any practice and/or process used in the specific organization for usability integration in agile projects? 3) How these practices and processes are carried out? 4) What artifacts are generated with the results of performing these specific practices and/or processes for usability integration in agile projects?	P1
AP-05 – Knowledge in the area of usability.	

1) Is there any initiative in the organization to promote knowledge in the area of usability? 2) Was the technical team trained to be knowledgeable in the area of usability? 3) Does the organization have a policy that encourages training in this area? 4) Do the professionals believe that training in this area will be useful for improving the quality of the final product?	P5
AP-06 –Top management support in the creation and implementation of policies that foster the integration between agile software development and usability.	
1) Does the organization's top management support the creation and implementation of policies that foster the integration of agile software development and usability? 2) Do top management consider usability as a way to add value to the software product?	P6
AP-07 – Organizational budget for investment in training of the technical staff for the integration of usability and agile software development.	
1) Does the company reserve organizational resource for investment in technical staff training in the area of usability? 2) Does the company reserve organizational resource for investment in coaching staff in the area of agile development?	P6
AP-08 – Prioritization of the usability issues during software development.	
1) Is there a tendency in the organization to prioritize the delivery of functional software, in a short period of time, to the detriment of usability? 2) If so, what are the factors that lead to this prioritization? 3) Is there a concern of the technical staff to integrate usability with agile software development? 4) Does the staff consider the integration of usability into software development important to the quality of the final product?	P1, P7, P8
AP-09 – User interface design effort.	
1) Does the technical staff perform any kind of prototyping of the system screens, whether in paper or mockups? 2) Does the technical staff carry out system prototyping (BDUF - Big Design Up Front) prior to implementation? 3) How much time (proportionally to the timebox) is dedicated to this activity?	P1, P8

AP-10 – Focus on usability tests.	
1) Does the technical staff perform unit tests on the developed software? 2) Does the technical staff perform usability tests on the developed software? 3) If so, which usability tests are performed? 4) Does the organization have metrics for measuring and tracking usability? 5) How are these metrics collected? How do these metrics contribute to the quality of the final product?	P1, P8
AP-11 – Involvement of system users in the development process.	
1) Is there a specific phase for the analysis and recognition of all users who will use the system during the process of development in the organization? 2) Are system users involved in the development process? 3) If so, in what ways are they involved? 4) Do these users' opinions affect the prioritization of the demands to be developed?	P1, P8

3.2.7 Relationship of points of analysis with propositions

In order to synthesize the results of each analysis point, regarding the unit of analysis, we used the format presented in Table 3-3. We choose the smile faces to interpret the findings as follow:

Table 3-3. Template of analysis points results presentation.

ANALYSIS POINTS	RESULTS
AP-n – Description of the analysis point.	Results of analysis point represented by: ☺ 😐 ☹

The judgment of the analysis points as well as of the propositions is given by the qualitative analysis of the contents treated in the semi-structured interviews. For this the following classifications were established:

☺ - The analysis point **was found** at any level in the organization.

😐 - The analysis point **was partially found** at any level in the organization.

☹ - The analysis point **was not found** at any level in the organization.

To finalize the analysis of each proposition, within each organization, another table format was used as described in Table 3-4. In this table were exposed the propositions and all points of analysis related, as well as their evaluations. For the final proposition analysis the following classifications were established:

✓ - The **proposition was considered true**.

ⓘ - The **proposition was considered partially true.**

✘ -The **proposition was not considered true**.

Table 3-4. Template of the final proposition result presentation.

PROPOSITION ANALYSIS	**RESULTS**
Detailed description of the proposition analysis	Final Results of the proposition analysis represented by: ✓ ✘
AP-n – Description of the analysis point.	Results of analysis point represented by: ☺ 😐 ☹

3.3 Development Phase

In the development phase of this research, we created a new approach called UXIAD - User eXperience Design Integration for Agile Development, which aims to integrate the user experience design into agile software development. At this stage,

we used the results of the case studies, as well as the mapping of the difficulties encountered by the industry, to create the new approach.

3.3.1 UXIAD

The proposed approach is based on an agile framework already consolidated in the market, Scrum. To make possible to integrate the concern with the end user experience with agile software development we decided to include specific roles, artifacts and practices allied to user-centered design approach and design thinking to accomplish this research goal as represented in Figure 3-3.

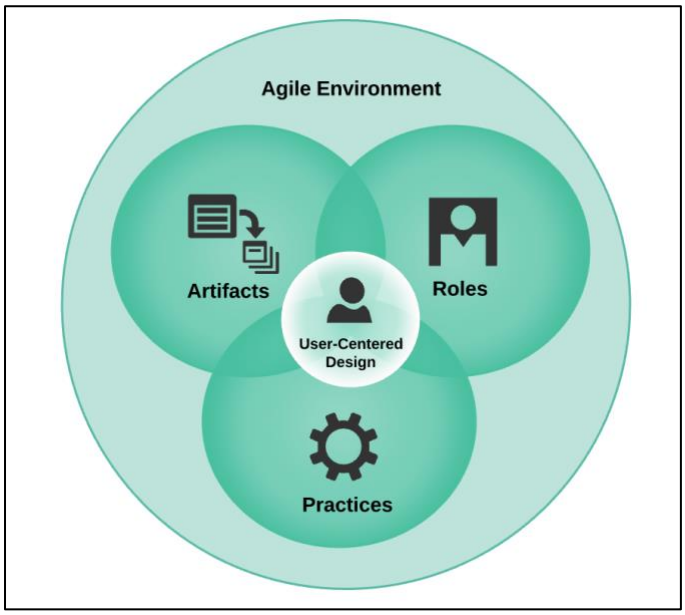

Figure 3-3. Representation of the integrated elements of the proposed approach.

3.4 Evaluation and Conclusion Phase

After designing the new approach, it was necessary to evaluate it. To perform it some steps were defined: scoping, planning, execution, analysis and presentation.

3.4.1 Defining the Scope

The scope of this evaluation was related to the analysis of the approach being proposed from two perspectives. The first one was related to users of the product generated as a result of using the approach, and the second one was related to the team involved with the use of the approach. The first perspective **analyzed** the new proposed approach **for the purpose of** evaluate the results obtained from the use of the proposed approach **with respect to** product perception, user emotions,

consequences of usage and attractiveness, **from the point of view of** the end users **in the context of** agile software development. The second perspective **analyzed** the new proposed approach **for the purpose of** evaluate its applicability **with respect to** perceived usefulness and ease of use, **from the point of view of** the team involved with the use of the new approach **in the context of** agile software development.

3.4.2 Planning the evaluation

Context Selection: This evaluation was conducted in a real company that was using the Scrum framework as agile methodology for software development and accepted to use the proposed approach. This choice was precisely to avoid a bias in the research, since in a company where agile methodologies are not used, the time and effort for learning it could distort the research results.

We selected companies that were concerned with user experience and usability issues and that work with low platform (including web development, desktop or mobile). In relation to the work team, we allocated resources as described in the proposed approach. To do so, we selected some specific roles:

- UX designer;
- Product Owner;
- Scrum Master;
- Developer;

In addition to these roles, we needed some specific functions to be performed, such as running functional tests, usability tests and building interfaces. Regarding to the development time and the size of the solution that was proposed, we expected to evaluation the new approach within one year, with short sprints of a maximum of two weeks. Thus, we could have time to conduct the analyzes and complete the evaluation. The researcher kept up with the team during the use of the proposed approach.

The general objectives of the evaluation are to analyze the applicability of the new proposed approach from two different viewpoints: end users, and the team involved with the use of the new approach. Considering this, a research question was formulated to serve as a guide for the investigation. For the first evaluation was defined the following research question:

How does the use of the proposed approach affect the outcome of the project development in relation to the user experience perceptions?

To evaluate the first perspective, related to the user's feedback, we worked as shown in Figure 3-4. We captured the user's experiences based on their experiences using the current software. To capture it we used the Modular Evaluation of key Components of User Experience (meCUE) questionnaire (MINGE et al., 2016). This questionnaire is presented in ANNEX A and consists of five separately validated modules which refer to instrumental and non-instrumental product perception, user emotions, consequences of usage, attractiveness and an overall evaluation. This questionnaire was sent to the actual users and the results were stored. Completing this phase, the team developed a new solution, to substitute the actual system, using the new proposed approach. After the product development was completed, it was used and evaluated by the same end users that already evaluated the actual software. After using the product, the users answered the questionnaire for the final evaluation regarding to user experience. Finishing it, the results were compared and analyzed through a qualitative analysis and it was verified whether the use of the new approach has affected the product development positively and improved the user experience.

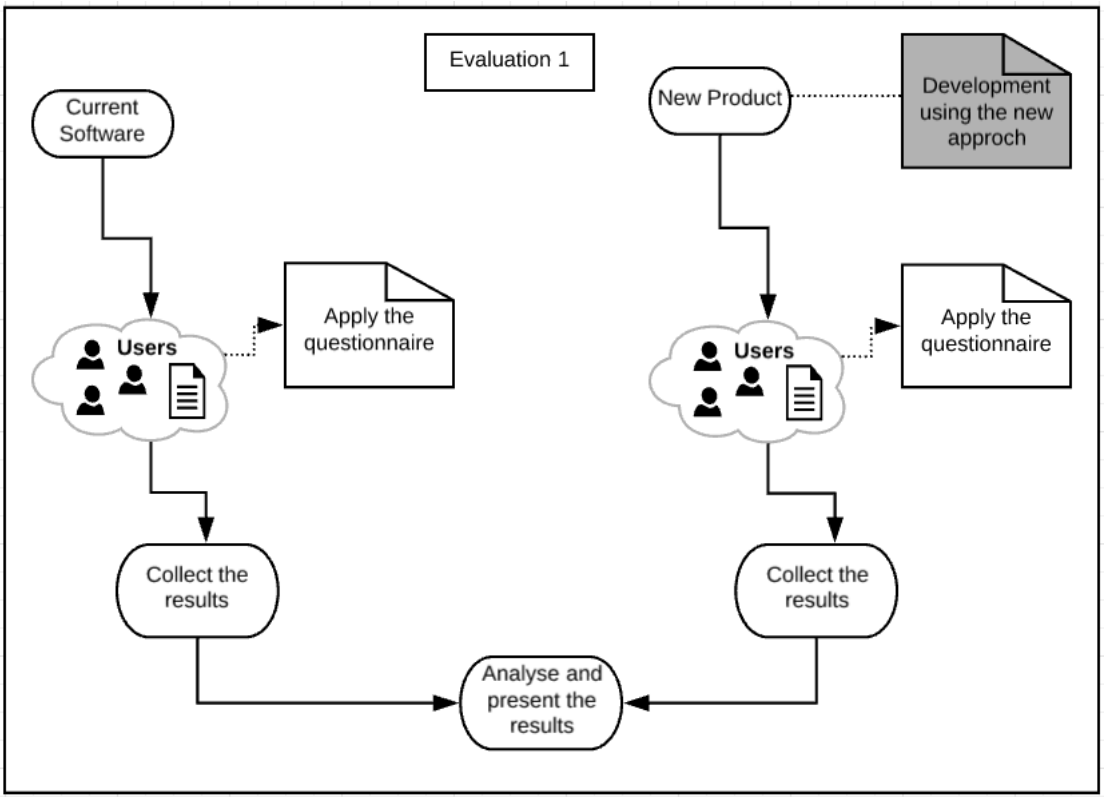

Figure 3-4. Graphical representation of the first evaluation.

To evaluate the second perspective, related to the team feedback, we applied a questionnaire but based on a different method of evaluation called TAM (Technology Acceptance Model) proposed by Davis, (1989). This model proposes to evaluate technologies according two perspectives: usefulness and ease of use. The questionnaire is presented in ANNEX B. As represented by Figure 3-5, the same team that developed the solution, with the proposed approach, was used in the application of this evaluation. At this stage, the goal was to capture feedback from the staff involved in the use of the new approach. For the second evaluation was defined the following research question:

Has the proposed new approach proved to be easy to use and useful in relation to the team's perception that was involved in the use of the proposed approach?

After collecting the results of the questionnaire, a qualitative analysis was conducted to verify whether the use of the new approach by the work team proved to be easy to use and useful.

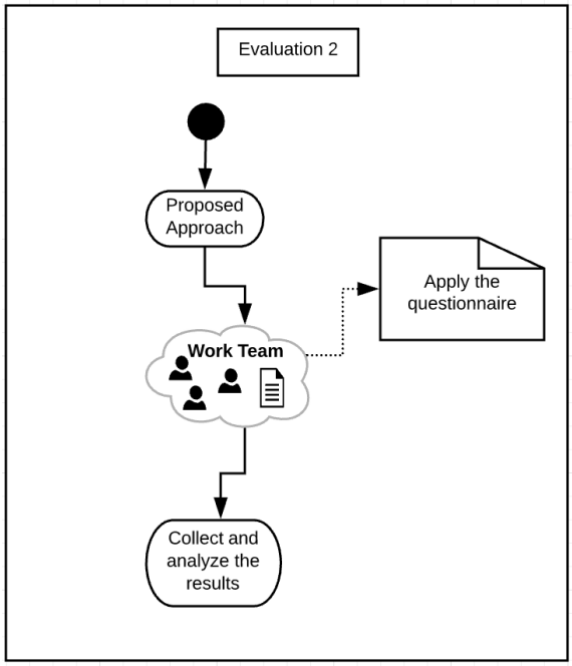

Figure 3-5. Graphical representation of the second evaluation.

3.4.3 Executing the evaluation

After the scoping and planning phases the evaluation was carried out in order to collect the data to be analyzed. This phase was very important because even having

designed the evaluation and the data collection perfectly, if the target audience have not participated seriously in the evaluation the results could be invalid.

To execute the first evaluation and considering the users point of view in relation to the current system, the Modular Evaluation of key Components of User Experience (meCUE) questionnaire was sent to be answered by the actual user in the beginning of the whole process. Each statement stablished in the questionnaire is assigned to a numeric value (Likert Scale) for evaluation. The statement “strongly disagree” is assigned to the value “1”, the statement “strongly agree” is assigned to the value “2”. The other responses options are similarly assigned with values “2” up to ”6” respectively: (disagree, somewhat disagree, neither agree nor disagree, agree). The statement in Module V (Overall Evaluation) differs from the other statements because it consists of a single semantic differential with the bipolar pair “bad” / “good” with values in a range between “-5”and “5”, with a scale interval of 0.5, as illustrated in Figure 3-6.

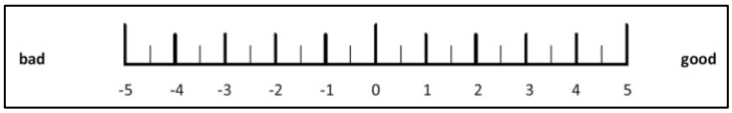

Figure 3-6. Example of the scale used for overall judgment.

We captured the actual user’s perceptions and compared their results with the final ones, when the same questionnaire was applied to the same users but focusing on capture the user’s perception related to the new product developed. Therefore, at the end of the product development, the questionnaire was sent back to the same users of the new system.

To execute the second evaluation, considering the team involved with the use of the new proposed approach another questionnaire was applied. In this case the TAM (Technology Acceptance Model) was sent to be answered by the team involved in the use of the new proposed approach at the end of the product development. This model proposes to evaluate technologies according two perspectives: usefulness and ease of use. Each sentence analyzed by the respondent had to be answered by a specific statement (strongly disagree, disagree, somewhat disagree, neither agree nor disagree, somewhat agree, agree and strongly agree). With this we explored the data collected and discussed the results from a qualitative point of view.

3.4.4 Analysis and presentation

After executing the evaluation, all data collected was used as input to the analysis and interpretation phase to draw valid conclusions.

In both evaluations, after collecting the results of the questionnaire, an analysis was conducted.

In the first evaluation as the questionnaire consists of five separately modules (Module I – Perception of instrumental qualities, Module II - Perception of non-instrumental qualities, Module III - User emotions, Module IV- Consequences of usage and Module V - Overall evaluation), the calculated mean values for each module were graphically summarized, as demonstrated in Figure 3-7.

The items assigned to each dimension are:

Module I: Usefulness, Usability

Module II: Visual aesthetics, Status, Commitment

Module III: Positive Emotions, Negative Emotions

Module IV: Intention to use, Product loyalty

Module V: Overall evaluation

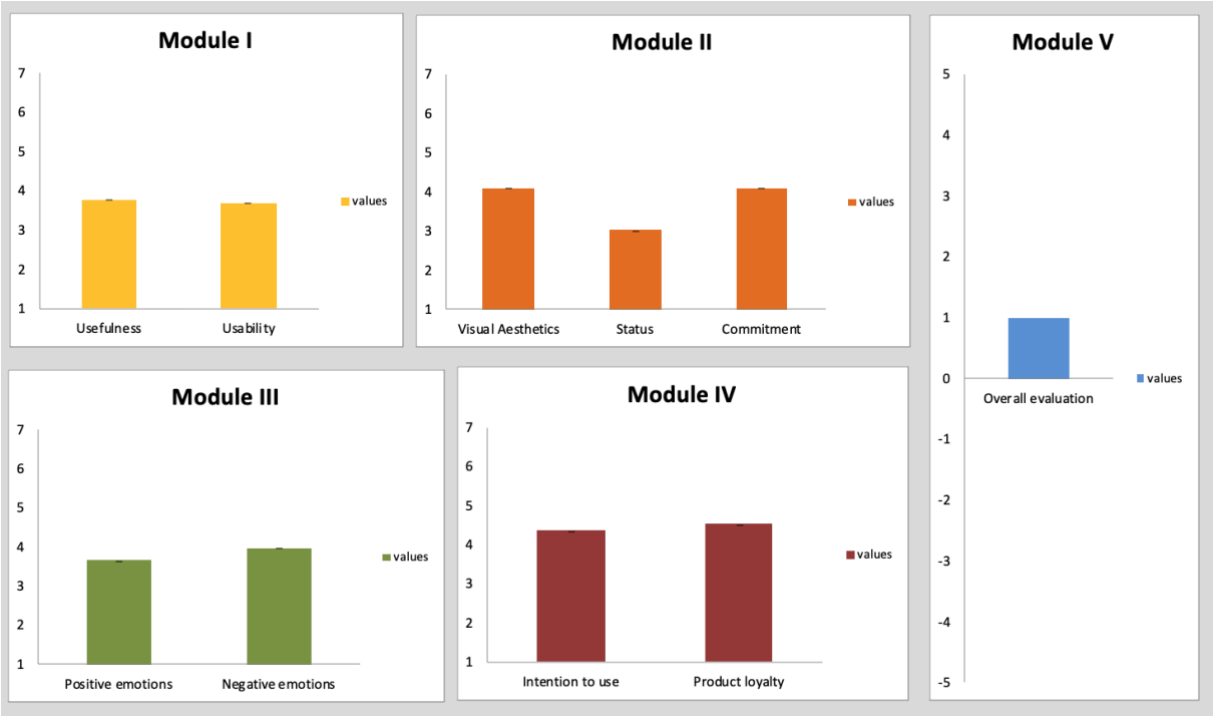

Figure 3-7. Example of the graphical representation of results.

With was possible to analyze the results and compare how the application of the new proposed approach affect the outcome of the project development in relation to the user's experiences perceptions. So, it was possible to compare the user's perception with the current solution panel to the user's perception with new solution developed panel, as demonstrated in Figure 3.8.

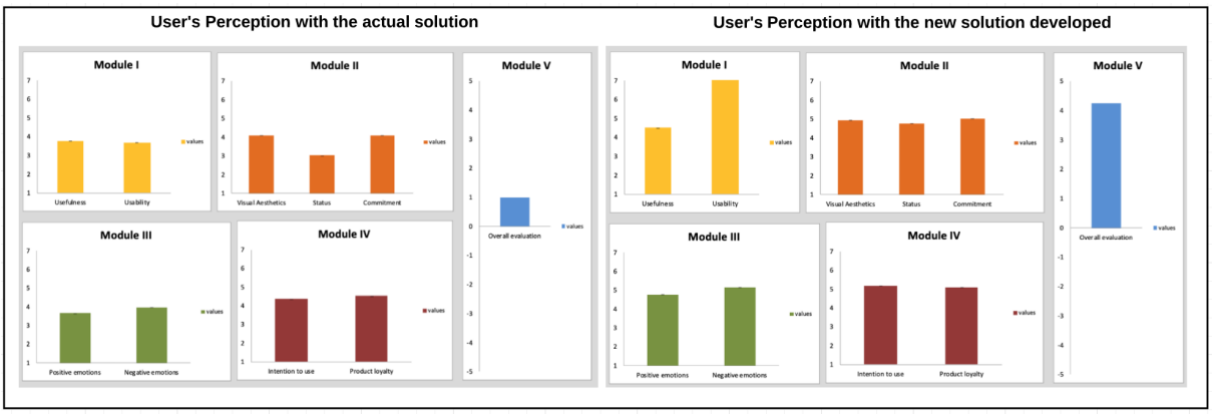

Figure 3-8. Dashboard with user's perceptions results.

With the results was possible to discuss the results and present the final conclusion related to how the use of the proposed approach affect the outcome of the project development in relation to the user experience perceptions.

After the execution of the second evaluation, using the TAM (Technology Acceptance Model), we presented, in a descriptive manner, the results obtained from all the people involved in the work team, as described in Table 3-5.

Table 3-5. Example of table to summarize the results of the applied TAM questionnaire.

Statement	Degree of agreement (person 1)	Degree of agreement (person 2)	Degree of agreement (person n)
My job would be difficult to perform without the new approach.	agree	somewhat disagree	agree
Using the new approach gives me greater control over my work.	neither agree nor disagree	strongly disagree	agree
Using the new approach improves my job performance.	agree	strongly agree	strongly agree

The idea was to analyze and discuss the results and verify whether the use of the new approach by the work team proved to be easy to use and useful.

3.5 Considerations about this chapter

In this chapter we provided all information about the research approaches and how it was conducted. The purpose is to make clear all the steps taken in conducting the research and also how the results were analyzed, since this is a qualitative research.

CHAPTER 4 - CASE STUDIES

After presenting the research approach, this chapter describes our case studies results and findings.

4.1 Case Studies Details

To present the results of the case studies information about each organization, employees involved in the interviews and all the analysis points provided in the research protocol were described. The data captured during the interviews are discussed and at the end the propositions are presented with individualized results.

For reasons of confidentiality companies were not identified. Fictitious names were used to present the results. Situations in which the organizations or the employees could be identified were omitted or generalized, guaranteeing the confidentiality of the information provided.

During the case studies 7 organizations were analyzed. The elements that compose the research protocol were used, including the research script, the operational procedure and the research protocol. A total of 20 companies were invited to participate, with different characteristics and sizes. Some of them did not participate due to lack of agenda or because they were no longer practicing agile methods. In all the organizations was tried to interview more than one profile to avoid the incorrect collection of information, especially those referring to the data of the organization. The interviews lasted on average between 40 and 50 minutes.

Altogether 16 people participated in the interviews that occupied the following positions:

- Designers
- System Managers
- UX Designers
- Product Owners
- Technical Leader
- Software Developer

- Software Developer Manager
- Director

To characterize the profile of the organizations, the standard used by the Ministry of Science and Technology in the production of the Quality Survey in the Brazilian Software Sector (MCT, 2009) was used as reference.

4.1.1 ORGANIZATION A

4.1.1.1 General Information

- **Activities of the organization:** Develops custom software.
- **Organization Characterization:**
  The capital of your organization is Private.
  The largest participation in the composition is National.
- **Best characterization of the organization's primary activity:** Development of all stages of the software life cycle.
  Elaboration of computer program (software factory practices).
- **Size according to the Organization's workforce:** More than 500 employees
- **Size as a function of the work force directly related to the development and maintenance of software products:** From 100 to 499 employees and outsourced employee.
- **Founded in:** 1991.
- **Customer service area:** Several areas.

4.1.1.2 Employee's profile

In this case study 2 professionals were interviewed and the details collected are presented in Table 4-1.

Table 4-1. Organization A - employee's profiles.

Organization A	Job Description	Working inside the organization	IT experience (Since graduation)	Interview Duration
Employee A	Designer	1 year	4 years	00:45:14
Employee B	System Manager	10 years	9 years	00:53:57

4.1.1.3 Organization A – Analysis Points description.

Descriptions regarding the analysis points of organization A are presented in APPENDIX E.

4.1.1.4 Organization A – Propositions Analysis

PROPOSITION ANALYSIS	RESULTS
P1 – Software development companies use the user-centered design approach combined with agile software development to address the usability of projects.	ⓘ
AP-04 – Practices and/or processes that combine the user-centered design approach with the agile software development, demonstrating the integration of usability to agile software development.	☺
AP-08 – Prioritization of usability issues during software development.	☹
AP-09 – User interface design effort.	😐
AP-10 – Focus on usability tests.	😐
AP-11 – Involvement of system users in the development process.	☺

For this proposition five analysis points were defined. All of them are related to the user-centered design approach. During the final analysis we found evidence that the organization used practices and process to combine user-centered design approach with agile software development and evidence of direct involvement of users in the development process. But on the other hand, we also find evidence that the organization was developing just some informal usability tests, was not prioritized the delivery of usable software over functional software and was not having employed

much effort on design user interfaces. Because of this we conclude that **this proposition was considered partially true**.

PROPOSITION ANALYSIS	RESULTS
P2 – There are software development companies in which the integration of usability to agile development is accomplished through the incorporation of usability specialists to the team without necessarily having specific practices defined in the development process.	ⓘ
AP-01 – Usability specialists in the composition of agile development teams.	😐

As this proposition was represented by only one analysis point and during the analysis was found the presence of usability specialists, represented by designers, web-designers, UX designer or any other profile related, only in some agile developer teams, it has given us indications of a concern to work more strongly on usability, but the small number of professionals prevents all agile projects from being composed of multidisciplinary professionals. Because of this we conclude that **this proposition was considered partially true**.

PROPOSITION ANALYSIS	RESULTS
P3 – There are software development companies where the integration of usability into agile software development is accomplished through the use of technologies and / or tools.	✓
AP-02 – Tools that help usability integration to software product development.	☺

As this proposition was represented by only one analysis point and during the analysis was found the presence of tools used to help the integration of usability into agile software development, **this proposition was considered true**.

PROPOSITION ANALYSIS	RESULTS
P4 – There are software development companies where the integration of usability into agile software development is associated with a specific type of development platform (web, mobile, etc).	✗
AP-03 – Focus of the integration of usability and agile software development for a specific type of development platform.	☹

As this proposition was represented by only one analysis point and during the analysis was not found evidence of dependencies between the integration of usability and agile software development to a specific type of development platform, **this proposition was not considered true**.

PROPOSITION ANALYSIS	RESULTS
P5 – The lack of knowledge and/or expertise in the area of usability is one of the main reasons that make it difficult to handle usability in agile software development.	ⓘ
AP-05 – Knowledge in the area of usability.	☺
AP-01 – Usability specialists in the composition of agile development teams.	😐

For this proposition two analysis points were defined. The first one is related to the presence of usability knowledge in the organization. During the analysis was possible to detect the existence of knowledge in this area and also different types of practices to disseminate it inside the organization. Related to the second analysis point we could notice that despite of the small number of professionals in this organization it did not avoid the organizations to select some specific projects to be composed by multidisciplinary professionals. In this case, is not possible to affirm that the lack of knowledge and/or expertise is making difficult to handle usability in agile software development. Because of this we concluded that **this proposition was considered partially true.**

PROPOSITION ANALYSIS	RESULTS
P6 – The difficulty of usability integration in agile software development is associated with the lack of support from top management.	✓
AP-06 –Top management support in the creation and implementation of policies that foster the integration between agile software development and usability.	☹
AP-07 – Organizational budget for investment in training of the technical staff for the integration of usability and agile software development.	☹

For this proposition two analysis points were defined. The first one is related to top management support in creation and implementation of policies to encourage the

integration between agile software development and usability. During the analysis it was noticed that concerns about usability issues are important but are not worked out and valued at the organization. The second proposition was related to existence of organizational budget for investment in training the technical staff, focusing on usability issues. During the analysis the interviewees report the existence of budget for training but not specific to the area of usability. Most of the trainings performed are more focused on development languages and new technologies. Because of this we concluded that **this proposition was considered true.**

PROPOSITION ANALYSIS	RESULTS
P7 – The need to deliver value to customers in a short time is one of the main factors that lead companies not to apply usability practices in agile software development.	✓
AP-08 – Prioritization of usability issues during software development.	☹

As this proposition was represented by only one analysis point and during the analysis was found evidence that demonstrate the prioritization of the organization in delivering functional software in detriment to usability. Functional aspects are much more valued due to cultural aspects of the company. Because of this we concluded that **this proposition was considered true.**

PROPOSITION ANALYSIS	RESULTS
P8 – The difficulty of usability integration in agile software development using a user-centered approach is associated with the large difference between the principles involved in each of these approaches.	ⓘ
AP-08 – Prioritization of usability issues during software development.	☹
AP-09 - User interface design effort.	😐
AP-10 – Focus on usability tests.	😐
AP-11 – Involvement of system users in the development process.	☺

For this proposition four analysis points were defined. All of them are related to the principles of user-centered design and agile software development. To carry out

the analysis of the propositions we have to take into account that when adopting a user-centered approach is expected to find:

1) Prioritization in deliver usable over functional software;
2) More activities related to up front design;
3) Activities related to usability tests;
4) Users are involved in all the design and development;

In our analysis it was possible to detect that the organization prioritizes the delivery of functional software, avoid prolonged phases of user interface design, and perform informal usability tests without using or collecting metrics. Only one of the proposed analysis points, related to user involvement was found during the investigation. As in most of the analysis points evidence has been found that the principles of the user-centered approach have not been adopted, we conclude that **this proposition was considered partially true.**

4.1.2 ORGANIZATION B

4.1.2.1 General Information

- **Activities of the organization:**
  Develops software for your own use.
  Develops software package (commercially available and ready-to-use software).
  Partially customize or modify software.
  Develops custom software.
  Develops embedded software.
- **Organization Characterization:**
  The capital of your organization is Private.
  The largest participation in the composition is National.
- **Best characterization of the organization's primary activity:** Development of all stages of the software life cycle
- **Size according to the Organization's workforce:** from 100 to 499 employees.

- **Size as a function of the work force directly related to the development and maintenance of software products:** From 10 to 49 employees and outsourced employee.
- **Founded in**:1989
- **Customer service area:** Retail

4.1.2.2 Employee's profile

For this case study 3 professionals were interviewed, and the details collected are presented in Table 4-2.

Table 4-2. Organization B - employee's profiles.

Organization B	Job Description	Working inside the organization	IT experience (Since graduation)	Interview Duration
Employee A	UX Designer	6 years	Not graduated	00:45:20
Employee B	Product Owner	7 years	6 years	00:58:44
Employee C	Software Developer	6 years	3,5 years	00:42:14

4.1.2.3 Organization B – Analysis Points description

Descriptions regarding the analysis points of organization B are presented in APPENDIX F.

4.1.2.4 Organization B – Propositions Analysis

PROPOSITION ANALYSIS	RESULTS
P1 – Software development companies use the user-centered design approach combined with agile software development to address the usability of projects.	ⓘ
AP-04 - Practices and/or processes that combine the user-centered design approach with the agile software development, demonstrating the integration of usability to agile software development.	☺
AP-08 – Prioritization of the usability issues during software development.	☹
AP-09 - User interface design effort.	😐

AP-10 – Focus on usability tests.	☹
AP-11 – Involvement of system users in the development process.	😐

For this proposition five analysis points were defined. All of them are related to the user-centered design approach. During the final analysis we found practices and processes that combine user-centered design with agile software development. But on the other hand, we found evidence that the organization prioritizes the delivery of functional over useful software, evidence that the organization does not perform usability tests, and evidence that the final users are rarely involved in the development process. As the organization has only one designer professional, we did not find evidence that the team really avoids prolonged phases of user interface design. This is only a consequence of the lack of professionals involved. Because of this we conclude that **this proposition was considered partially true**.

PROPOSITION ANALYSIS	RESULTS
P2 – There are software development companies in which the integration of usability to agile development is accomplished through the incorporation of usability specialists to the team without necessarily having specific practices defined in the development process.	ⓘ
AP-01 – Usability specialists in the composition of agile development teams.	😐

This proposition was represented by only one analysis point and during the analysis was not found the presence of usability specialists, represented by designers, web-designers, UX designer or any other profile related, in all agile teams. It has given us indications that the organization does not prepare multidisciplinary teams to conduct their projects. They have only one professional to attend all demands of the company. Because of this we concluded that **this proposition was considered partially true.**

PROPOSITION ANALYSIS	RESULTS
P3 – There are software development companies where the integration of usability into agile software development is accomplished through the use of technologies and / or tools.	✓

AP-02 – Tools that help usability integration to software product development.	☺

As this proposition was represented by only one analysis point and during the analysis was found the presence of tools used to help the integration of usability into agile software development, **this proposition was considered true**.

PROPOSITION ANALYSIS	RESULTS
P4 – There are software development companies where the integration of usability into agile software development is associated with a specific type of development platform (web, mobile and etc).	✓
AP-03 – Focus of the integration of usability and agile software development for a specific type of development platform.	☺

As this proposition was represented by only one analysis point and during the analysis we found evidence of dependencies between the integration of usability and agile software development to a specific type of development platform, **this proposition was considered true**.

PROPOSITION ANALYSIS	RESULTS
P5 – The lack of knowledge and/or expertise in the area of usability is one of the main reasons that make it difficult to handle usability in agile software development.	ⓘ
AP-05 – Knowledge in the area of usability.	☹
AP-01 – Usability specialists in the composition of agile development teams.	😐

For this proposition two analysis points were defined. The first one is related to usability knowledge in the organization. During the analysis was possible to detect the lack of knowledge in this area and also the lack of interest of the entire organization in bringing the discussion on this topic. Related to the second analysis point we could notice that only one professional is responsible by the design area of the whole company. Based on the evidence encountered is possible to affirm that the lack of knowledge and expertise is making difficult to handle usability in agile software

development. Because of this we concluded that **this proposition was considered true.**

PROPOSITION ANALYSIS	RESULTS
P6 – The difficulty of usability integration in agile software development is associated with the lack of support from top management.	✓
AP-06 –Top management support in the creation and implementation of policies that foster the integration between agile software development and usability.	☹
AP-07 – Organizational budget for investment in training of the technical staff for the integration of usability and agile software development.	☹

For this proposition two analysis points were defined. The first one is related to top management support in creation and implementation of policies to encourage the integration between agile software development and usability. During the analysis it was noticed that the organization does not have as priority topics related to the usability of the products developed. The top management does not support the creation or implementation of policies to foster the integration between agile software development and usability. The second proposition was related to organizational budget for investment in training the technical staff, focusing in usability issues. During the analysis the interviewees reported the absence of budget for trainings in the area of usability. Because of this we concluded that **this proposition was considered true.**

PROPOSITION ANALYSIS	RESULTS
P7 – The need to deliver value to customers in a short time is one of the main factors that lead companies not to apply usability practices in agile software development.	✓
AP-08 – Prioritization of usability issues during software development.	☹

This proposition was represented by only one analysis point and during the analysis evidence that demonstrate the prioritization of the organization in delivering functional software in detriment to usability were found. Functional aspects are much more valued due to cultural aspects of the company. Because of this we concluded that **this proposition was considered true.**

PROPOSITION ANALYSIS	RESULTS
P8 – The difficulty of usability integration in agile software development using a user-centered approach is associated with the large difference between the principles involved in each of these approaches.	ⓘ
AP-08 – Prioritization of usability issues during software development.	☹
AP-09 - User interface design effort.	😐
AP-10 – Focus on usability tests.	☹
AP-11 – Involvement of system users in the development process.	😐

For this proposition four analysis points were defined. All of them are related to the principles of user-centered design and agile software development. To carry out the analysis of the propositions we have to take into account that when adopting a user-centered approach is expected to find:

1) Prioritization in deliver usable over functional software;
2) More activities related to up front design;
3) Activities related to usability tests;
4) Users are involved in all the design and development;

In our analysis was possible to detect that the organization prioritizes the delivery of functional software, avoid prolonged phases of user interface design, does not perform usability tests or collecting metrics and does not involve the final system users into the development process. As none of the principles of the user-centered design approach addressed by the analysis points have been adopted, we conclude that **this proposition was considered partially true.**

4.1.3 ORGANIZATION C

4.1.3.1 General Information

- **Activities of the organization:**
  Develops software for your own use.
  Partially customize or modify software.
  Develops custom software.

- **Organization Characterization:**
  The capital of your organization is Private.
  The largest participation in the composition is National.
- **Best characterization of the organization's primary activity:** Development of all stages of the software life cycle
  Software and hardware integration
- **Size according to the Organization's workforce:** from 100 to 499 employees.
- **Size as a function of the work force directly related to the development and maintenance of software products:** From 100 to 499 employees and outsourced employee.
- **Founded in:** 1996
- **Customer service area:** initially focused on telecom but also opened the doors to serve different areas.

4.1.3.2 Employee's profile

For this case study 4 professionals were interviewed and the details collected are presented in Table 4-3.

Table 4-3. Organization C - employee's profiles.

Organization C	Job Description	Working inside the organization	IT experience (Since graduation)	Interview Duration
Employee A	Web Designer	1 year	8 years	00:57:44
Employee B	Technical Leader	9 years	17 years	00:41:13
Employee C	Software Developer	1,5 years	10 years	00:35:06
Employee D	Software Developer Manager	12 years	16 years	00:39:43

4.1.3.3 Organization C– Analysis Points description

Descriptions regarding the analysis points of organization C are presented in APPENDIX G.

4.1.3.4 Organization C – Propositions Analysis

PROPOSITION ANALYSIS	RESULTS
P1 – Software development companies use the user-centered design approach combined with agile software development to address the usability of projects.	ⓘ
AP-04 – Practices and/or processes that combine the user-centered design approach with the agile software development, demonstrating the integration of usability to agile software development.	☺
AP-08 – Prioritization of usability issues during software development.	☺
AP-09 – User interface design effort.	☺
AP-10 – Focus on usability tests.	☹
AP-11 – Involvement of system users in the development process.	☺

During the analysis of this organization many practices related to user-centered design approach are being used combined with agile software development. They are concerned with issues related to the development of interfaces and the experiences that it can produce to users. They are interested in deliver not just useful but usable software too and to promote better experiences the organization always involves the system's users in the development process. The only aspect that the organization is not yet organized to perform is related to usability tests in the development process. Because of this we conclude that **this proposition was considered partially true**.

PROPOSITION ANALYSIS	RESULTS
P2 – There are software development companies in which the integration of usability to agile development is accomplished through the incorporation of usability specialists to the team without necessarily having specific practices defined in the development process.	ⓘ
AP-01 – Usability specialists in the composition of agile development teams.	😐

This proposition was represented by only one analysis point and during the analysis was not found the presence of usability specialists, represented by designers, web-designers, UX designer or any other profile related, in all agile teams. The organization has recently created a new sector to include usability and UX concerns to software development process. Today they have only two practitioners working in this area that are attending all projects of the organization. Their responsibilities are related to develop corporative guidelines and create patterns for the visual identity issues (including fields, colors, fonts and rules) and integrate the developer to the whole creative process. It has given us indications that the organization does not prepare multidisciplinary teams to conduct their projects. Because of this we concluded that **this proposition was considered partially true.**

PROPOSITION ANALYSIS	RESULTS
P3 – There are software development companies where the integration of usability into agile software development is accomplished through the use of technologies and / or tools.	✓
AP-02 – Tools that help usability integration to software product development.	☺

As this proposition was represented by only one analysis point and during the analysis was found the presence of tools used to help the integration of usability into agile software development, **this proposition was considered true**.

PROPOSITION ANALYSIS	RESULTS
P4 – There are software development companies where the integration of usability into agile software development is associated with a specific type of development platform (web, mobile, etc).	✓
AP-03 – Focus of the integration of usability and agile software development for a specific type of development platform.	☺

As this proposition was represented by only one analysis point and during the analysis we found evidence of dependencies between the integration of usability and agile software development to a specific type of development platform, **this proposition could be considered true**.

PROPOSITION ANALYSIS	RESULTS
P5 – The lack of knowledge and/or expertise in the area of usability is one of the main reasons that make it difficult to handle usability in agile software development.	ⓘ
AP-05 – Knowledge in the area of usability.	☺
AP-01 – Usability specialists in the composition of agile development teams.	😐

For this proposition two analysis points were defined. The first one is related to usability knowledge in the organization. During the analysis of this organization was possible to detect the presence of knowledge in the area of usability and user experience. The organization is investing on it and created a new sector to include usability and UX concerns to software development process. As the organization is beginning the processes of including issues related to UX and usability, they do not have the necessary number of employees to compose all development teams. Today they have only two professional working in this area that are attending all projects of the organization. Because of this we concluded that **this proposition was considered partially true.**

PROPOSITION ANALYSIS	RESULTS
P6 – The difficulty of usability integration in agile software development is associated with the lack of support from top management.	✘
AP-06 –Top management support in the creation and implementation of policies that foster the integration between agile software development and usability.	☺
AP-07 – Organizational budget for investment in training of the technical staff for the integration of usability and agile software development.	☺

For this proposition two analysis points were defined. The first one is related to top management support in creation and implementation of policies to encourage the integration between agile software development and usability. During the analysis it was noticed that the top management support the creation or implementation of policies to foster the integration between agile software development and usability. The second proposition was related to organizational budget for investment in training the technical staff, focusing in usability issues. During the analysis the interviewees

reported that the organization does not have a specific budget for trainings in the area of usability, but employees can suggest and request for specific training or to participate in congresses and workshops. Because of this we concluded that **this proposition was not considered true.**

PROPOSITION ANALYSIS	RESULTS
P7 – The need to deliver value to customers in a short time is one of the main factors that lead companies not to apply usability practices in agile software development.	✘
AP-08 – Prioritization of usability issues during software development.	☺

This proposition was represented by only one analysis point and during the analysis evidence that demonstrate the organization concerns in deliver not just functional software but also usable software. Functional aspects are so important as usability an UX aspects. Because of this we concluded that **this proposition was not considered true.**

PROPOSITION ANALYSIS	RESULTS
P8 – The difficulty of usability integration in agile software development using a user-centered approach is associated with the large difference between the principles involved in each of these approaches.	✘
AP-08 – Prioritization of usability issues during software development.	☺
AP-09 - User interface design effort.	☺
AP-10 – Focus on usability tests.	☹
AP-11 – Involvement of system users in the development process.	☺

For this proposition four analysis points were defined. All of them are related to the principles of user-centered design and agile software development. To carry out the analysis of the propositions we have to take into account that when adopting a user-centered approach is expected to find:

1) Prioritization in deliver usable over functional software;
2) More activities related to up front design;

3) Activities related to usability tests;
4) Users are involved in all the design and development;

In our analysis we could detect that the organization does not prioritizes the delivery of functional software, does not avoid prolonged phases of user interface design, does not perform usability tests and involve the final system users into the development process. As almost all principles of the user-centered design approach addressed by the analysis points have been adopted, we conclude that **this proposition was not considered to true.**

4.1.4 ORGANIZATION D

4.1.4.1 General Information

- **Activities of the organization:**
  Develops software for your own use.
  Develops embedded software.
- **Organization Characterization:**
  The capital of your organization is Private.
  The largest participation in the composition is National.
- **Best characterization of the organization's primary activity:** Development of all stages of the software life cycle
- **Size according to the Organization's workforce:** from 50 to 99 employees.
- **Size as a function of the work force directly related to the development and maintenance of software products:** From 10 to 49 employees and outsourced employee.
- **Founded in:** 1997
- **Customer service area:** Logistics.

4.1.4.2 Employee's profile

For this case study 1 practitioner was interviewed and the details collected are presented in Table 4-4.

Table 4-4. Organization D - employee's profiles.

Organization D	Job Description	Working inside the organization	IT experience (Since graduation)	Interview Duration
Employee A	Designer	3 years	14 years	00:48:57

4.1.4.3 Organization D– Analysis Points description

Descriptions regarding the analysis points of organization D are presented in APPENDIX H.

4.1.4.4 Organization D – Propositions Analysis

PROPOSITION ANALYSIS	RESULTS
P1 – Software development companies use the user-centered design approach combined with agile software development to address the usability of projects.	ⓘ
AP-04 – Practices and/or processes that combine the user-centered design approach with the agile software development, demonstrating the integration of usability to agile software development.	😐
AP-08 – Prioritization of the usability issues during software development.	😐
AP-09 – User interface design effort.	☺
AP-10 – Focus on usability tests.	😐
AP-11 – Involvement of system users in the development process.	☺

For this proposition five analysis points were defined. All of them are related to the user-centered design approach. During the final analysis we found few practices and processes related to user-centered design combined to agile software development. We found evidence that, not in all cases, the organization prioritizes the delivery of functional over useful software. Most part of the time the organization performs usability tests, and evidence that the final users are always involved in the development process. Despite of having just one designer to work with all the demands we found evidence that there is a design effort at the beginning of the projects to

develop a “Big Design Upfront”. Because of this we conclude that **this proposition was considered partially true**.

PROPOSITION ANALYSIS	RESULTS
P2 – There are software development companies in which the integration of usability to agile development is accomplished through the incorporation of usability specialists to the team without necessarily having specific practices defined in the development process.	ⓘ
AP-01 – Usability specialists in the composition of agile development teams.	😐

This proposition was represented by only one analysis point and during the analysis was not found the presence of usability specialists, represented by designers, web-designers, UX designer or any other profile related, in all agile teams.

Interviewees gave us indications that the organization does not prepare multidisciplinary teams to conduct their projects. They have only one professional to attend all demands of the company. Because of this we concluded that **this proposition was considered partially true.**

PROPOSITION ANALYSIS	RESULTS
P3 – There are software development companies where the integration of usability into agile software development is accomplished through the use of technologies and / or tools.	✓
AP-02 – Tools that help usability integration to software product development.	☺

As this proposition was represented by only one analysis point and during the analysis was found the presence of tools used to help the integration of usability into agile software development, **this proposition was considered true**.

PROPOSITION ANALYSIS	RESULTS
P4 – There are software development companies where the integration of usability into agile software development is associated with a specific type of development platform (web, mobile, etc).	✓
AP-03 – Focus of the integration of usability and agile software development for a specific type of development platform.	☺

As this proposition was represented by only one analysis point and during the analysis we found evidence of dependencies between the integration of usability and agile software development to a specific type of development platform, **this proposition was considered true**.

PROPOSITION ANALYSIS	RESULTS
P5 – The lack of knowledge and/or expertise in the area of usability is one of the main reasons that make it difficult to handle usability in agile software development.	ⓘ
AP-05 – Knowledge in the area of usability.	☹
AP-01 – Usability specialists in the composition of agile development teams.	😐

For this proposition two analysis points were defined. The first one is related to usability knowledge in the organization. During the analysis was possible to detect the lack of knowledge in this area. The organization is still immature and is starting to prioritize the user experience and get knowledge in the area of usability. Related to the second analysis point we could notice that only one professional is responsible by the design area of the whole company. As they have simultaneous projects is quite impossible to assemble multidisciplinary teams. Based on the evidence encountered is possible to affirm that the lack of knowledge and expertise is making difficult to handle usability in agile software development. Because of this we concluded that **this proposition was considered partially true.**

PROPOSITION ANALYSIS	RESULTS
P6 – The difficulty of usability integration in agile software development is associated with the lack of support from top management.	✓
AP-06 –Top management support in the creation and implementation of policies that foster the integration between agile software development and usability.	☹
AP-07 – Organizational budget for investment in training of the technical staff for the integration of usability and agile software development.	☹

For this proposition two analysis points were defined. The first one is related to top management support in creation and implementation of policies to encourage the integration between agile software development and usability. During the analysis it

was noticed that the organization does not have as priority topics related to the usability or UX of the developed products. The top management does not support the creation or implementation of policies to foster the integration between agile software development and usability. The second proposition was related to organizational budget for investment in training the technical staff, focusing on usability issues. During the analysis the interviewees reported the absence of specific budget for trainings in the area of usability or UX. Employees in general can suggest training in specific areas, but the acceptance depends on the management analysis. Because of this we concluded that **this proposition was considered true.**

PROPOSITION ANALYSIS	RESULTS
P7 – The need to deliver value to customers in a short time is one of the main factors that lead companies not to apply usability practices in agile software development.	ⓘ
AP-08 – Prioritization of the usability issues during software development.	😐

This proposition was represented by only one analysis point and during the analysis evidence that demonstrate the organization despite of not having much investment on usability and UX the organization does not prioritize the delivery of functional software over usability all the time. But as they do not have enough UX or designer professionals to be allocated in all projects, they are forced to deliver value in short time and do not apply usability practices. Because of this we concluded that **this proposition was considered partially true.**

PROPOSITION ANALYSIS	RESULTS
P8 – The difficulty of usability integration in agile software development using a user-centered approach is associated with the large difference between the principles involved in each of these approaches.	ⓘ
AP-08 – Prioritization of the usability issues during software development.	😐
AP-09 - User interface design effort.	☺
AP-10 – Focus on usability tests.	😐
AP-11 – Involvement of system users in the development process.	☺

For this proposition four analysis points were defined. All of them are related to the principles of user-centered design and agile software development. To carry out the analysis of the propositions we have to take into account that when adopting a user-centered approach we expect to find:

1) Prioritization in deliver usable over functional software;
2) More activities related to up front design;
3) Activities related to usability tests;
4) Users are involved in all the design and development;

In our analysis was possible to detect that the organization sometimes prioritizes the delivery of functional software, does not avoid prolonged phases of user interface design, perform some usability tests, collect some metrics and involve the final system users into the development process. As all of the principles of the user-centered design approach were only partially addressed by the analysis points, we conclude that **this proposition was considered partially true.**

4.1.5 ORGANIZATION E

4.1.5.1 General Information

- **Activities of the organization:**
  Develops software for your own use.
  Develops custom software.
- **Organization Characterization:**
  The capital of your organization is Private.
  The largest participation in the composition is National.
- **Best characterization of the organization's primary activity:** Development of all stages of the software life cycle
- **Size according to the Organization's workforce:** from 100 to 499 employees.
- **Size as a function of the work force directly related to the development and maintenance of software products:** From 50 to 99 employees and outsourced employee.
- **Founded in:** 2008

- **Customer service area:** Several areas.

4.1.5.2 Employee's profile

For this case study two practitioners were interviewed and the details collected are presented in Table 4-5.

Table 4-5. Organization E - employee's profiles.

Organization E	Job Description	Working inside the organization	IT experience (Since graduation)	Interview Duration
Employee A	UX Designer	9 months	16 years	00:50:01
Employee B	Developer	3,5 years	4 years	01:06:05

4.1.5.3 Organization E– Analysis Points description

Descriptions regarding the analysis points of organization E are presented in APPENDIX I.

4.1.5.4 Organization E – Propositions Analysis

PROPOSITION ANALYSIS	RESULTS
P1 – Software development companies use the user-centered design approach combined with agile software development to address the usability of projects.	ⓘ
AP-04 - Practices and/or processes that combine the user-centered design approach with the agile software development, demonstrating the integration of usability to agile software development.	😐
AP-08 – Prioritization of the usability issues during software development.	😐
AP-09 - User interface design effort.	☺
AP-10 – Focus on usability tests.	☹
AP-11 – Involvement of system users in the development process.	☺

For this proposition five analysis points were defined. All of them are related to the user-centered design approach. During the final analysis we found evidence that they involve the final users in the software development process and are concerned in produce navigable prototypes. We also detected that, not in all cases, the organization prioritizes the delivery of functional over useful software. Despite of having tools that enable the integration of agile development and user-centered design we cannot say that they are completely integrated because the activities related to UX and usability are done before the development process start. We did not find evidence of performing usability tests. Because of this we conclude that **this proposition was considered partially true**.

PROPOSITION ANALYSIS	RESULTS
P2 – There are software development companies in which the integration of usability to agile development is accomplished through the incorporation of usability specialists to the team without necessarily having specific practices defined in the development process.	ⓘ
AP-01 – Usability specialists in the composition of agile development teams.	😐

This proposition was represented by only one analysis point and during the analysis was not found the presence of usability specialists, represented by designers, web-designers, UX designer or any other profile related, in all agile teams or allocated full time. During the interviews it was possible to detect that the organization has two separated departments: one for development and other for design. The design department is responsible to start the requirements analysis with the costumers and final users, produce wireframes and navigable prototypes, but everything is done before the software development starts which is called as “Discovery” phase. It has given us indications that despite of preparing multidisciplinary teams to conduct their projects the usability issues are not addressed inside of agile teams and the participations of the designers during the software development ends up being very punctual. Because of this we concluded that **this proposition was considered partially true.**

PROPOSITION ANALYSIS	RESULTS
P3 – There are software development companies where the integration of usability into agile software development is accomplished through the use of technologies and / or tools.	✓
AP-02 – Tools that help usability integration to software product development.	☺

As this proposition was represented by only one analysis point and during the analysis was found the presence of tools used to help the integration of usability into agile software development, **this proposition was considered true**.

PROPOSITION ANALYSIS	RESULTS
P4 – There are software development companies where the integration of usability into agile software development is associated with a specific type of development platform (web, mobile..etc).	✓
AP-03 – Focus of the integration of usability and agile software development for a specific type of development platform.	☺

As this proposition was represented by only one analysis point and during the analysis we found evidence of dependencies between the integration of usability and agile software development to a specific type of development platform, **this proposition was considered true**.

PROPOSITION ANALYSIS	RESULTS
P5 – The lack of knowledge and/or expertise in the area of usability is one of the main reasons that make it difficult to handle usability in agile software development.	ⓘ
AP-05 – Knowledge in the area of usability.	☺
AP-01 – Usability specialists in the composition of agile development teams.	😐

For this proposition two analysis points were defined. The first one is related to usability knowledge in the organization. During the analysis we detected evidence that the organization has invested in the last years in the area of usability and user experience and intend to disseminate the knowledge in the area. Related to the second analysis point we could notice that despite of the organization has multidisciplinary

team to conduct their projects, the usability issues are not addressed inside of agile teams and the participations of the designers during the software development ends up being very punctual. Based on the evidence encountered is not possible to affirm that the lack of knowledge and expertise is making difficult to handle usability in agile software development. Because of this we concluded that **this proposition was considered partially true.**

PROPOSITION ANALYSIS	RESULTS
P6 – The difficulty of usability integration in agile software development is associated with the lack of support from top management.	ⓘ
AP-06 –Top management support in the creation and implementation of policies that foster the integration between agile software development and usability.	☺
AP-07 – Organizational budget for investment in training of the technical staff for the integration of usability and agile software development.	😐

For this proposition two analysis points were defined. The first one is related to top management support in creation and implementation of policies to encourage the integration between agile software development and usability. During the analysis it was noticed that the top management recognize the importance of understand the final user expectations and their experiences. Because of this they give support for new ideas and promote practices to improve the quality of the final product. The second proposition was related to organizational budget for investment in training the technical staff, focusing in usability issues. During the analysis the interviewees reported the absence of specific budget for trainings in the area of usability or UX. Employees in general can suggest training in specific areas, but the acceptance depends on the management analysis. Because of this we concluded that **this proposition was be considered partially true.**

PROPOSITION ANALYSIS	RESULTS
P7 – The need to deliver value to customers in a short time is one of the main factors that lead companies not to apply usability practices in agile software development.	ⓘ
AP-08 – Prioritization of the usability issues during software development.	😐

This proposition was represented by only one analysis point and during the analysis we found evidence that demonstrate the organization, in some cases, prioritizes the delivery of functional software over usable software. Criteria related to the client's deadlines and tight budgets are forcing the development of lean solutions and without so much study or usability testing with users. Because of this we concluded that **this proposition was considered partially true.**

PROPOSITION ANALYSIS	RESULTS
P8 – The difficulty of usability integration in agile software development using a user-centered approach is associated with the large difference between the principles involved in each of these approaches.	ⓘ
AP-08 – Prioritization of the usability issues during software development.	😐
AP-09 - User interface design effort.	☺
AP-10 – Focus on usability tests.	☹
AP-11 – Involvement of system users in the development process.	☺

For this proposition four analysis points were defined. All of them are related to the principles of user-centered design and agile software development. To carry out the analysis of the propositions we have to take into account that when adopting a user-centered approach is expected to find:

1) Prioritization in deliver usable over functional software;
2) More activities related to up front design;
3) Activities related to usability tests;
4) Users are involved in all the design and development;

In our analysis was possible to detect that the organization sometimes prioritizes the delivery of functional software, does not avoid prolonged phases of user interface design, does not perform usability tests and involve the final system users into the development process. As just one of the principles of the user-centered design approach is not addressed by the analysis points, we conclude that **this proposition was considered partially true.**

4.1.6 ORGANIZATION F

4.1.6.1 General Information

- **Activities of the organization:**
  Develops software for your own use.
  Develops custom software.
  Develops embedded software.
- **Organization Characterization:**
  The capital of your organization is Private.
  The largest participation in the composition is National.
- **Best characterization of the organization's primary activity:** Development of all stages of the software life cycle
- **Size according to the Organization's workforce:** from 50 to 99 employees.
- **Size as a function of the work force directly related to the development and maintenance of software products:** From 10 to 49 employees and outsourced employee.
- **Founded in:** 2004.
- **Customer service area:** Health.

4.1.6.2 Employee's profile

For this case study 1 practitioner was interviewed and the details collected are presented in Table 4-6.

Table 4-6. Organization F - employee's profiles.

Organization F	Job Description	Working inside the organization	IT experience (Since graduation)	Interview Duration
Employee A	UX Designer	6 years	5 years	00:51:58

4.1.6.3 Organization F– Analysis Points description

Descriptions regarding the analysis points of organization F are presented in APPENDIX J.

4.1.6.4 Organization F – Propositions Analysis

PROPOSITION ANALYSIS	RESULTS
P1 – Software development companies use the user-centered design approach combined with agile software development to address the usability of projects.	✓
AP-04 - Practices and/or processes that combine the user-centered design approach with the agile software development, demonstrating the integration of usability to agile software development.	☺
AP-08 – Prioritization of usability issues during software development.	☺
AP-09 - User interface design effort.	☺
AP-10 – Focus on usability tests.	☺
AP-11 – Involvement of system users in the development process.	☺

For this proposition five analysis points were defined. All of them are related to the user-centered design approach. During the final analysis we detected that all practices related to user-centered design combined to agile software development were fully applied. We found evidence that the organization did not prioritize the delivery of functional over useful software. They also involve the final users in the software development process and are concerned in produce navigable prototypes. We also find evidence of performing usability tests. Because of this we conclude that **this proposition was considered true.**

PROPOSITION ANALYSIS	RESULTS
P2 – There are software development companies in which the integration of usability to agile development is accomplished through the incorporation of usability specialists to the team without necessarily having specific practices defined in the development process.	ⓘ
AP-01 – Usability specialists in the composition of agile development teams.	😐

This proposition was represented by only one analysis point and during the analysis was found the presence of usability specialists, represented by designers, web-designers and UX designer allocated in all agile teams. During the interviews it was possible to detect that there are no separated departments to work with design and software development. Because of this we concluded that **this proposition was considered partially true.**

PROPOSITION ANALYSIS	RESULTS
P3 – There are software development companies where the integration of usability into agile software development is accomplished through the use of technologies and / or tools.	✓
AP-02 – Tools that help usability integration to software product development.	☺

As this proposition was represented by only one analysis point and during the analysis was found the presence of tools used to help the integration of usability into agile software development, **this proposition was considered true**.

PROPOSITION ANALYSIS	RESULTS
P4 – There are software development companies where the integration of usability into agile software development is associated with a specific type of development platform (web, mobile, etc).	✗
AP-03 – Focus of the integration of usability and agile software development for a specific type of development platform.	☹

As this proposition was represented by only one analysis point and during the analysis we did not found evidence of dependencies between the integration of usability and agile software development to a specific type of development platform, **this proposition was not considered true**.

PROPOSITION ANALYSIS	RESULTS
P5 – The lack of knowledge and/or expertise in the area of usability is one of the main reasons that make it difficult to handle usability in agile software development.	ⓘ

AP-05 – Knowledge in the area of usability.	☺
AP-01 – Usability specialists in the composition of agile development teams.	😐

For this proposition two analysis points were defined. The first one is related to usability knowledge in the organization. During the analysis we detected evidence that the organization has invested in the last years in the area of usability and user experience and intend to disseminate the knowledge in the area. Related to the second analysis point we could notice that the organization has multidisciplinary team to conduct their projects, the usability issues are addressed inside of agile teams. But today the organization has only three designers available to work with the development teams. Based on the evidence encountered is not possible to affirm that the lack of knowledge and expertise is making difficult to handle usability in agile software development. Because of this we concluded that **this proposition was considered partially true.**

PROPOSITION ANALYSIS	RESULTS
P6 – The difficulty of usability integration in agile software development is associated with the lack of support from top management.	ⓘ
AP-06 –Top management support in the creation and implementation of policies that foster the integration between agile software development and usability.	☺
AP-07 – Organizational budget for investment in training of the technical staff for the integration of usability and agile software development.	😐

For this proposition two analysis points were defined. The first one is related to top management support in creation and implementation of policies to encourage the integration between agile software development and usability. During the analysis it was noticed that the top management recognize the importance of understand the final user expectations and their experiences. Because of this they give support for new ideas and promote practices to improve the quality of the final product. The second proposition was related to organizational budget for investment in training the technical staff, focusing on usability issues. During the analysis the interviewees reported the absence of specific budget for trainings in the area of usability or UX. Employees in general can suggest training in specific areas, but the acceptance depends on the

management analysis. Because of this we concluded that **this proposition was be considered partially true.**

PROPOSITION ANALYSIS	RESULTS
P7 – The need to deliver value to customers in a short time is one of the main factors that lead companies not to apply usability practices in agile software development.	✘
AP-08 – Prioritization of usability issues during software development.	☺

This proposition was represented by only one analysis point and during the analysis we found evidence that demonstrate the organization did not prioritizes the delivery of functional software over usable software. The organization recognizes the importance of usability issues and how the final user experience is valuable for their business. Because of this we concluded that **this proposition was not considered true.**

PROPOSITION ANALYSIS	RESULTS
P8 – The difficulty of usability integration in agile software development using a user-centered approach is associated with the large difference between the principles involved in each of these approaches.	✘
AP-08 – Prioritization of usability issues during software development.	☺
AP-09 - User interface design effort.	☺
AP-10 – Focus on usability tests.	☺
AP-11 – Involvement of system users in the development process.	☺

For this proposition four analysis points were defined. All of them are related to the principles of user-centered design and agile software development. To carry out the analysis of the propositions we have to take into account that when adopting a user-centered approach is expected to find:

1) Prioritization in deliver usable nor functional software;
2) More activities related to up front design;
3) Activities related to usability tests;
4) Users are involved in all the design and development;

In our analysis was possible to detect that the organization does not prioritizes the delivery of functional software, does not avoid prolonged phases of user interface design, perform usability tests and involve the final system users into the development process. As all principles of the user-centered design approach are addressed by the analysis points, we conclude that **this proposition was not considered true.**

4.1.7 ORGANIZATION G

4.1.7.1 General Information

- **Activities of the organization:**
  Develops software for your own use.
  Partially customize or modify software.
  Develops custom software.
- **Organization Characterization:**
  The capital of your organization is Private.
  The largest participation in the composition is National.
- **Best characterization of the organization's primary activity:**
  Development of all stages of the software life cycle
- **Size according to the Organization's workforce:** from 50 to 99 employees.
- **Size as a function of the work force directly related to the development and maintenance of software products:** From 10 to 49 employees and outsourced employee.
- **Founded in:** 1995.
- **Customer service area:** initially focused on telecom and finances but also opened the doors to serve different areas.

4.1.7.2 Employee's profile

For this case study 3 practitioners were interviewed and the details collected are presented in Table 4-7.

Table 4-7. Organization G - employee's profiles.

Organization G	Job Description	Working inside the organization	IT experience (Since graduation)	Interview Duration
Employee A	Developer	3 years	8 years	01:04:45
Employee B	UX Designer	2 years	23 years	00:59:02
Employee C	Director	22 years	38 years	00:56:57

4.1.7.3 Organization G– Analysis Points description

Descriptions regarding the analysis points of organization G are presented in APPENDIX K.

4.1.7.4 Organization G – Propositions Analysis

PROPOSITION ANALYSIS	RESULTS
P1 – Software development companies use the user-centered design approach combined with agile software development to address the usability of projects.	ⓘ
AP-04 - Practices and/or processes that combine the user-centered design approach with the agile software development, demonstrating the integration of usability to agile software development.	☺
AP-08 – Prioritization of usability issues during software development.	☹
AP-09 - User interface design effort.	☺
AP-10 – Focus on usability tests.	😐
AP-11 – Involvement of system users in the development process.	😐

For this proposition five analysis points were defined. All of them are related to the user-centered design approach. During the final analysis we detected that only two practices related to user-centered design combined to agile software development were fully applied. We found evidence that the organization prioritizes the delivery of functional over usable software. They did not involve the final users in the software development process and we also did not find evidence of performing usability tests.

They are just concerned in produce navigable prototypes in the beginning of the projects. Because of this we conclude that **this proposition was considered partially true**.

PROPOSITION ANALYSIS	RESULTS
P2 – There are software development companies in which the integration of usability to agile development is accomplished through the incorporation of usability specialists to the team without necessarily having specific practices defined in the development process.	ⓘ
AP-01 – Usability specialists in the composition of agile development teams.	😐

This proposition was represented by only one analysis point and during the analysis was not found the presence of usability specialists, represented by designers, web-designers and UX designer allocated in all agile teams. On the other hand, we cannot say that the organization did not provide it to their clients.

During the interviews it was possible to detect that a specialist outside the organization is frequently hired to work on specific projects that require more elaborated skills to develop the user interfaces. This specialist works on specific tasks and usually is not involved in all sprints. Because of this we concluded that **this proposition was considered partially true.**

PROPOSITION ANALYSIS	RESULTS
P3 – There are software development companies where the integration of usability into agile software development is accomplished through the use of technologies and / or tools.	✓
AP-02 – Tools that help usability integration to software product development.	☺

As this proposition was represented by only one analysis point and during the analysis was found the presence of tools used to help the integration of usability into agile software development, **this proposition was considered true**.

PROPOSITION ANALYSIS	RESULTS
P4 – There are software development companies where the integration of usability into agile software development is associated with a specific type of development platform (web, mobile, etc).	✓
AP-03 – Focus of the integration of usability and agile software development for a specific type of development platform.	☺

As this proposition was represented by only one analysis point and during the analysis we found evidence of dependencies between the integration of usability and agile software development to a specific type of development platform, **this proposition was considered true**.

PROPOSITION ANALYSIS	RESULTS
P5 – The lack of knowledge and/or expertise in the area of usability is one of the main reasons that make it difficult to handle usability in agile software development.	ⓘ
AP-05 – Knowledge in the area of usability.	😐
AP-01 – Usability specialists in the composition of agile development teams.	😐

For this proposition two analysis points were defined. The first one is related to usability knowledge in the organization. During the analysis we detected evidence that the knowledge in the area of usability and user experience inside the organization is very restricted. Few members of the development team have knowledge or is interested in study this area. Related to the second analysis point we could notice that the organization did not work with the concept of multidisciplinary team to conduct their projects. When it is necessary an external specialist is hired to work on specific demands. Based on the evidence encountered is possible to affirm that the lack of knowledge and expertise is making difficult to handle usability in agile software development. Because of this we concluded that **this proposition was considered partially true.**

PROPOSITION ANALYSIS	RESULTS
P6 – The difficulty of usability integration in agile software development is associated with the lack of support from top management.	✘
AP-06 –Top management support in the creation and implementation of policies that foster the integration between agile software development and usability.	☺
AP-07 – Organizational budget for investment in training of the technical staff for the integration of usability and agile software development.	☺

For this proposition two analysis points were defined. The first one is related to top management support in creation and implementation of policies to encourage the integration between agile software development and usability. During the analysis it was noticed that the top management recognize the importance of understand the final user expectations and their experiences. Because of this they give support for new ideas and promote practices to improve the quality of the final product. The second proposition was related to organizational budget for investment in training the technical staff, focusing in usability issues. During the analysis the interviewees reported that there is no specific budget for trainings in the area of usability or UX, but the organization offers financial support (30%of the total amount) to those employees who wish to undertake a postgraduate or improvements in their area of activity in the organization.

Employees in general can suggest training in specific areas but the acceptance depends on the management analysis. Because of this we concluded that **this proposition was not considered true.**

PROPOSITION ANALYSIS	RESULTS
P7 – The need to deliver value to customers in a short time is one of the main factors that lead companies not to apply usability practices in agile software development.	✓
AP-08 – Prioritization of usability issues during software development.	☹

This proposition was represented by only one analysis point and during the analysis we found evidence that demonstrate the organization did not prioritizes the delivery of functional software over usable software. Criteria related to the client's deadlines and tight budgets are forcing the development of lean solutions and without

so much study or usability testing with users. Because of this we concluded that **this proposition was considered true.**

PROPOSITION ANALYSIS	RESULTS
P8 – The difficulty of usability integration in agile software development using a user-centered approach is associated with the large difference between the principles involved in each of these approaches.	ⓘ
AP-08 – Prioritization of usability issues during software development.	☹
AP-09 - User interface design effort.	☺
AP-10 – Focus on usability tests.	😐
AP-11 – Involvement of system users in the development process.	😐

For this proposition four analysis points were defined. All of them are related to the principles of user-centered design and agile software development. To carry out the analysis of the propositions we have to take into account that when adopting a user-centered approach is expected to find:

1) Prioritization in deliver usable over functional software;
2) More activities related to up front design;
3) Activities related to usability tests;
4) Users are involved in all the design and development;

In our analysis was possible to detect that the organization prioritizes the delivery of functional software, avoid prolonged phases of user interface design but always produce navigable prototypes, does not focus on performing usability tests and frequently does not involve the final system users into the development process. As just one of the principles of the user-centered design approach was addressed by the analysis points, we conclude that **this proposition was considered partially true.**

4.2 Consolidation of results

As previously reported, seven case studies were performed, which were conducted through semi-structured interviews. The intention was to make an analysis

of each proposition taking into account the result obtained in each of the organizations to arrive at a final result, as demonstrated in Table 4-8.

Table 4-8. Overview of propositions analysis result.

Propositions	Organizations							Final Result
	A	B	C	D	E	F	G	
P1 – Software development companies use the user-centered design approach combined with agile software development to address the usability of projects.	ⓘ	ⓘ	ⓘ	ⓘ	ⓘ	✓	ⓘ	ⓘ
P2 – There are software development companies in which the integration of usability to agile development is accomplished through the incorporation of usability specialists to the team without necessarily having specific practices defined in the development process.	ⓘ	ⓘ	ⓘ	ⓘ	ⓘ	ⓘ	ⓘ	ⓘ
P3 – There are software development companies where the integration of usability into agile software development is accomplished through the use of technologies and / or tools.	✓	✓	✓	✓	✓	✓	✓	✓
P4 – There are software development companies where the integration of usability into agile software development is associated with a specific type of development platform (web, mobile, etc.)	✗	✓	✓	✓	✓	✗	✓	ⓘ
P5 – The lack of knowledge and/or expertise in the area of usability is one of the main reasons that make it difficult to handle usability in agile software development.	ⓘ	ⓘ	ⓘ	ⓘ	ⓘ	ⓘ	ⓘ	ⓘ

P6 – The difficulty of usability integration in agile software development is associated with the lack of support from top management.	✓	✓	✗	✓	ⓘ	ⓘ	✗	ⓘ
P7 – The need to deliver value to customers in a short time is one of the main factors that lead companies not to apply usability practices in agile software development.	✓	✓	✗	ⓘ	ⓘ	✗	✓	ⓘ
P8 – The difficulty of usability integration in agile software development using a user-centered approach is associated with the large difference between the principles involved in each of these approaches.	ⓘ	ⓘ	✗	ⓘ	ⓘ	✗	ⓘ	ⓘ

After the analysis of each organization, it was possible to identify and summarize some results related to the propositions. For the proposition **P1 we could conclude that it can be considered partially true**, because the majority of the organizations are adopting aspects of the user center design approach. We could notice that in 5 out of 7 organizations are involving the users in all design and development phases. They put the users on the center of the discussion and avoid prolonged phases of user interface design but always produce navigable prototypes. Only 3 of 7 organizations are really concentrated on develop functional and not usable software, but only 1 of 7 develop some informal usability tests with the users. This brings us the idea that all requirements are collected with them but they are rarely tested.

The proposition **P2 we could conclude that it can be considered partially true**, because we could notice that the majority of the organizations are interested in developing their products including the usability concerns even not having the necessary number of skilled people, including web developers, designers, UI designers or UX designers, to attend the whole organizational demands. Because of this we find evidence in some organizations that only some specific projects were selected to be built with multidisciplinary teams. We also find evidence that some

organizations (A, E, F) were working with parallel tracks (one for developers and another for designers) during the sprints, which help the team and work integration to achieve the same objective.

The only proposition analyzed that we found unanimity was P3. **For this proposition we could conclude that it can be considered true.** After analyzing all organizations we could find evidence that all of them use some kind of tool or technology that accomplish the integration of usability and agile software development. Most of them are tools for designing, prototyping, building mockups and wireframes. Some organizations also use some tools for modeling workflows or to build artifacts like the user journeys. These tools facilitate the communication between the members of the agile teams and also between the team and the final users.

The proposition **P4 we could conclude that it can be considered partially true** because we could notice that in 5 out of 7 organizations we found evidence that the integration of usability into agile software development is associated with a specific type of development platform. In general, the organizations pay more attention to usability issues when are developing for mobile devices. It is probably related to their small length and how they can provide better user experiences. But we also find evidence of organizations that develop solutions for specific hardware's (like raspberry or locomotive onboard computers) that are also worried with usability issues.

We could conclude that P5 can be considered partially true because we also noticed that in 5 out of 7 organizations the lack of knowledge and/or expertise in the area of usability is one of the main reasons that make difficult to handle usability in agile software development. The employees are usually focused on deliver value to their client, so they dedicate their time on studying new development languages, new tools or frameworks that helps to deliver software more frequently and in short periods of time. Non-functional requirements are not their priority so the knowledge in this area ends up becoming focused on specific areas of the organization. Another factor that impacted this conclusion is the absence of a specialist inside the development team. As already presented the majority of the organization are concerned with it but does not have the necessary number of professionals to be allocated in all agile projects.

For the **proposition P6 we could conclude that it can be considered partially true** because we did not find evidence that proves the difficulty of usability integration in agile software development is associated with the lack of support from top management. In most cases the top managers agree that usability and user

experience concerns are important for the organization and for the quality of the final product. They provide tools to integrate the team, organizational environment to develop it and stimulate the communication. But they do not have a specific budget to invest on trainings for the technical staff. This turns difficult the knowledge sharing and the updating of professionals with market trends.

For the **proposition P7 we could conclude that it can be considered partially true** because we could find evidence in 5 out 7 organizations that the need to deliver value to customers in a short time is one of the main factors that lead companies not to apply usability practices in agile software development. We noticed that in some organizations despite of having the support of the top managers the pressure of the market to deliver the products as soon as possible prevent the technical staff to work harder on usability and user experience issues.

For the proposition P8 we could conclude that it can be considered partially true because we could find some evidence that the difficulty of usability integration in agile software development using a user-centered approach is associated with the large difference between the principles involved in each of these approaches. The user centered design approach is based on some principles like: no prioritizations in deliver functional software; the presence of more activities related to up front design and activities focused on usability tests; involvement of the users in all the design and development phases. In 4 out of 7 organizations we could find strong evidence of difficulty associated with the large difference between the principles involved in each of these approaches. In most of the organization (5 out of 7) we could find evidence of the users involvement in all development phases and efforts to include more activities related to up front design. But a minimum number of organizations were really executing usability tests. We could notice that when they were done, only informal tests were performed and no data were stored to perform studies or benchmark.

4.3 General conclusions

In this section was presented some general conclusion drawn from the interviews that may contribute to the creation of the proposed new approach. The conclusions and observations were made through 4 perspectives: **roles, teams, practices and tools.**

Roles: During the course of the case studies, it was tried to interview different profiles (professionals with different roles in the organization) for which the results of the interviews were complementary. One of the factors that drew attention was precisely in relation to the role of UX designers. Some of the interviewees had this job description but did not perform tasks and activities of an UX designer. We perceive a lack of clarity within organizations in defining the activities of an UI designer and an UX designer. It was noticed that in many times the activities of the UX designers were much more related to the creation of standards for the interfaces than a concern with the feelings, sensations, emotions, interactive behavior and the user experience that the produced product would provoke in the end user. This has drawn our attention because much is said about UX and the role of the UX designer in software development, but few companies have the knowledge of what their role really is and in what steps or how this professional should be allocated.

Teams: In relation to team formation, it was also possible to identify different ways in which companies are organizing their teams in order to create multidisciplinary teams. In the organization A the development teams were created by both profiles of software developers and designers. But these professionals came from different departments that worked in parallel during the sprints, as shown in Figure 4-1. There was clearly this boundary in the company, because while it had hundreds of software developers available, the design team worked with only 12 professionals to answer to the entire demand of the company. Therefore, the design professionals were not allocated full time in the teams for the development of the solution. There was a very punctual participation for the definition of layout, wireframes, visual identity and then left the team to meet others demands of the company.

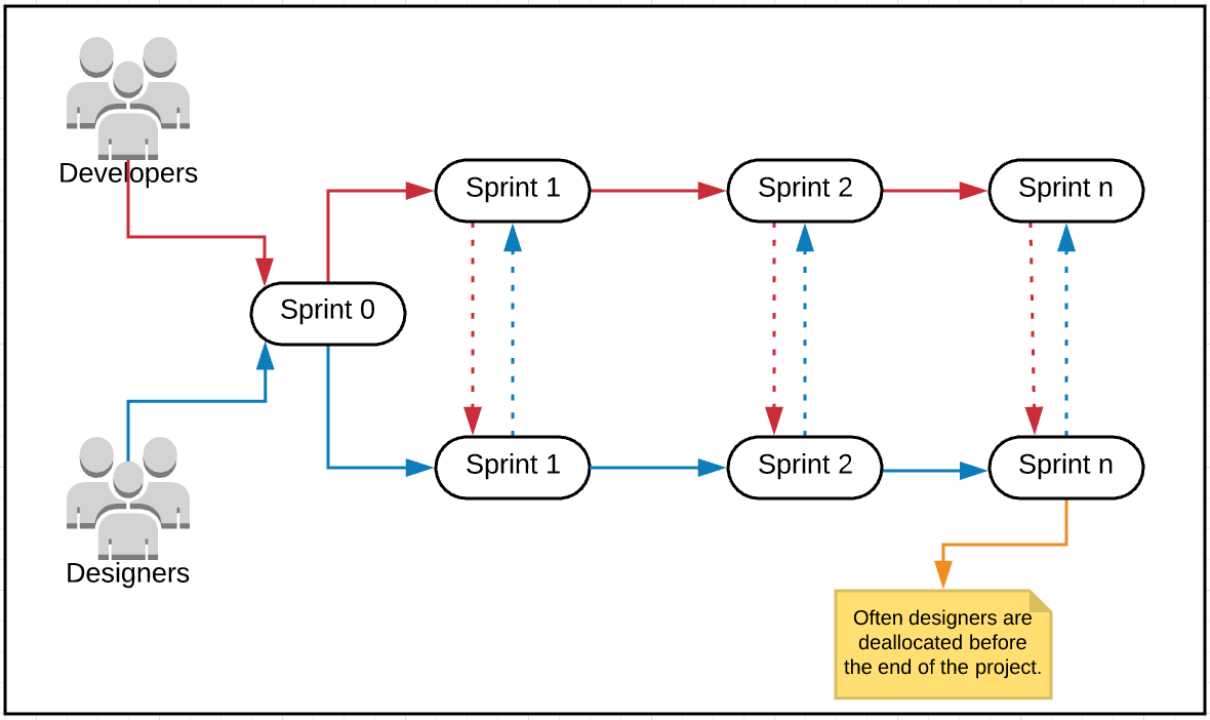

Figure 4-1. Representation of the work scheme in the organization A.

In the organization B analyzed it was also possible to identify a concern related to usability issues, but only for the new projects. New managers understand that nowadays if new projects do not have a concern with usability issues and user experience the company will not become competitive in the market. However, today the company has only one professional assigned to deal with the demands of the entire organization, making it difficult to answer the demands already deployed. As represented in Figure 4-2 the designer is always present in the meetings of Sprint 0 but can hardly actively participate in other Sprints. Because of this all the activities that involve the concern with the usability and user interface improvement of the legacy software has been abandoned.

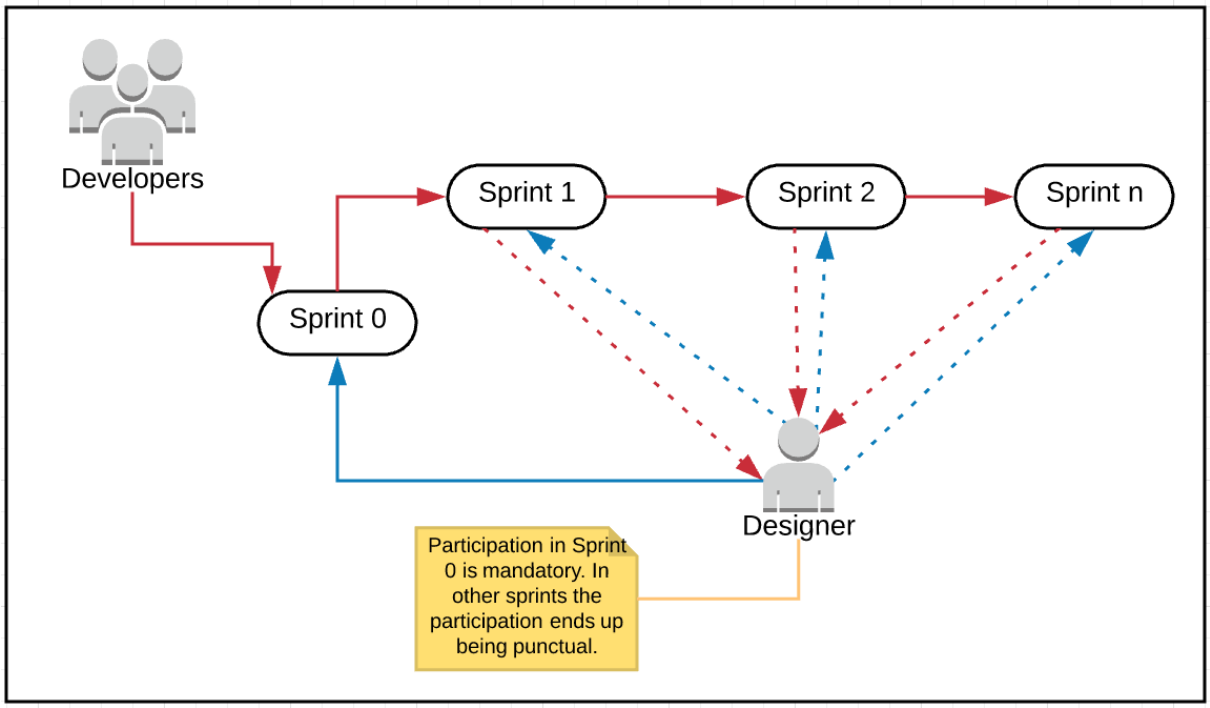

Figure 4-2. Representation of the work scheme in the organization B.

In the organization C it was possible to identify that the concern with the improvement in product quality, mainly in issues related to usability and user experience, has become one of the main themes. With this, top management has been supporting and investing in order to incorporate in its processes a way to integrate agile development with the improvement of the user experience. A new UX team was recently created and currently two employees are working full-time to not only improve the design of the interfaces, but also to establish organizational standards and improve the usability of the products. Figure 4-3 represent the dynamics of the company in relation to the integration of the UX team in the development environment. Most developers are full-stack developers and therefore have the knowledge and skills to work with front-end and back-end. Development teams are therefore not staffed by multidisciplinary teams, but the UX team can provide consulting services or even assist in the creation of prototypes for specific services, such as mobile prototypes. The UX team therefore is not responsible for developing the design interfaces, but rather prototypes that are constantly validated by customers. This approach favors the understanding of the demand and mainly the critical points of the business.

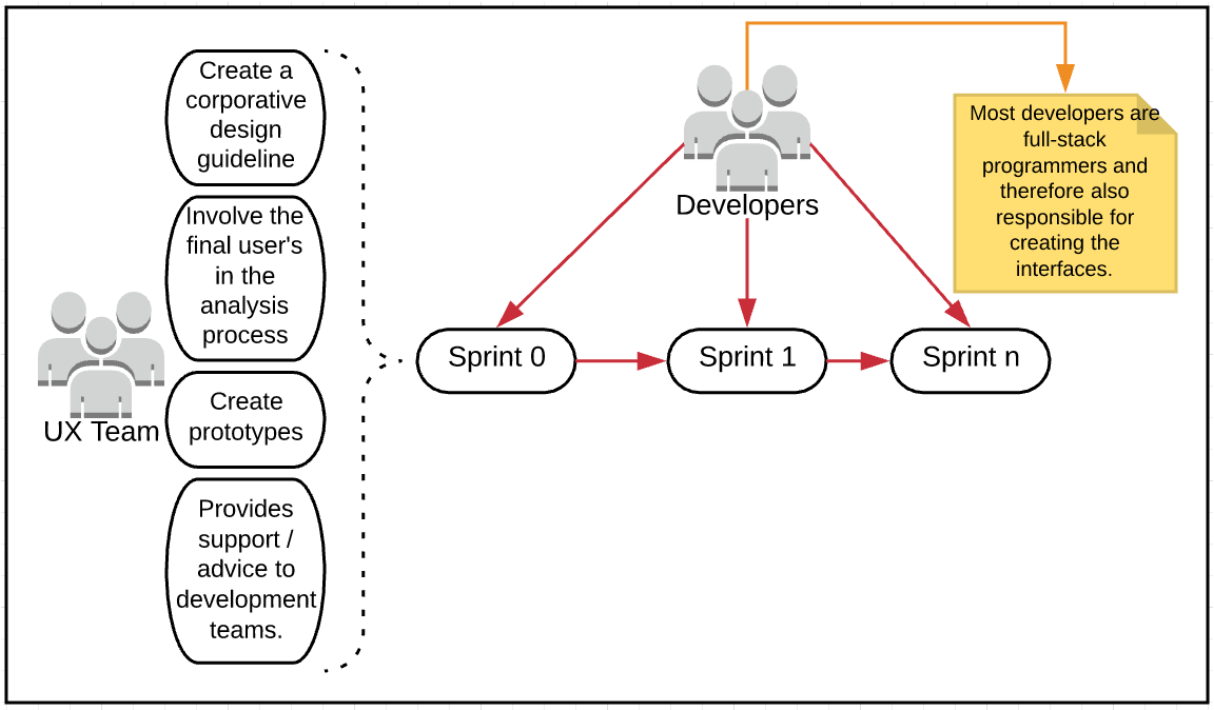

Figure 4-3. Representation of the work scheme in the organization C.

In the organization D it was possible to identify that although the organization recognizes that issues related to usability and user experience are important, there is no established priority and very high investments in this area. Currently the organization has only one designer who is responsible for answer the demands of the entire Organization as represented in Figure 4-4. In the case of this organization few new products are created and therefore the greatest work is in maintaining and improving existing products. That is why in maintenance or in the creation of new functionalities the designer is able to produce prototypes of the solution as a whole.

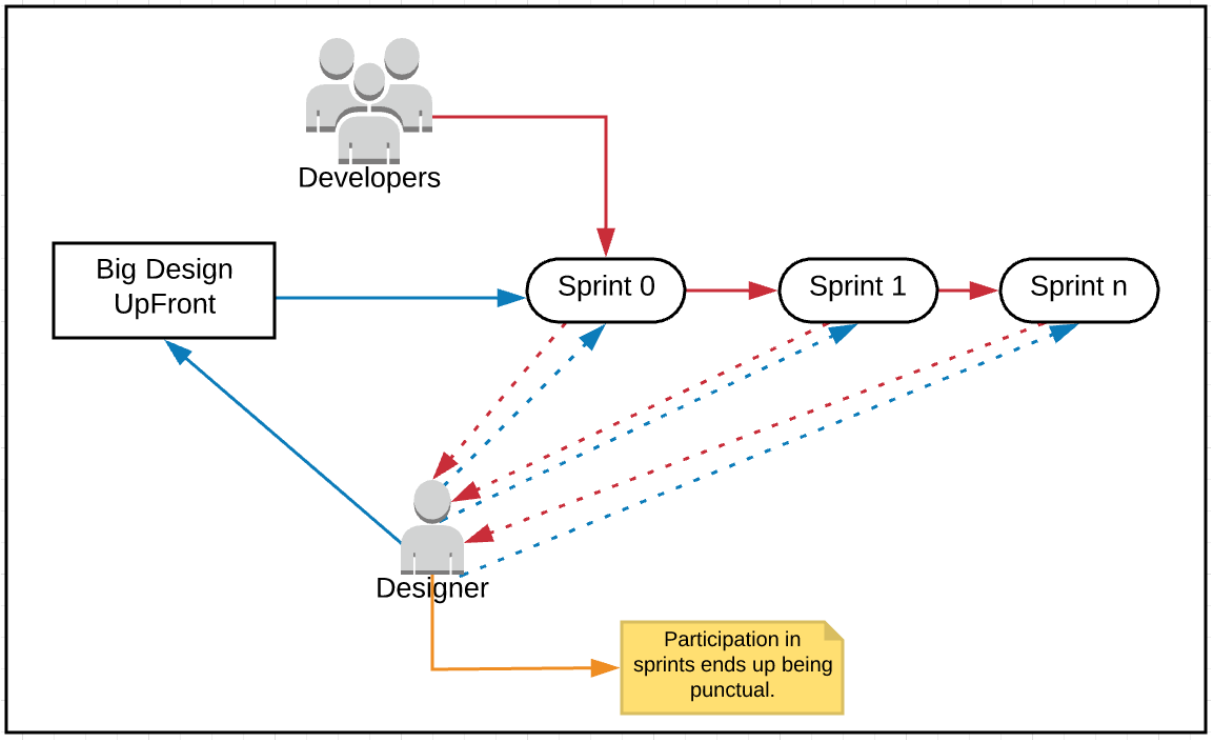

Figure 4-4. Representation of the work scheme in the organization D.

In the organization E we were able to detect a repetition of the team composition pattern. That's because when we looked at the organization A, it was also possible to detect that they also had a specific team of designers who are able to be allocated and work with development team demands. Developers and designer work in different departments, but during the development process multidisciplinary teams are created including both profiles: developers and designers.

They usually work in parallel during the sprints, as shown in Figure 4-5. Actually, five resources are available to provide this kind of service for the whole organization. The design department is responsible to start the requirements analysis with the costumers and final users, produce wireframes and navigable prototypes. Typically, the development teams are multidisciplinary which includes the participation, but not for full time, of a designer. So, the vast majority of usability and user experience concerns are solved or improved by the design team before implementation starts. The organization calls this phase of the project as “Discovery” phase. The participation of the designers in the development teams during the software development therefore ends up being very punctual.

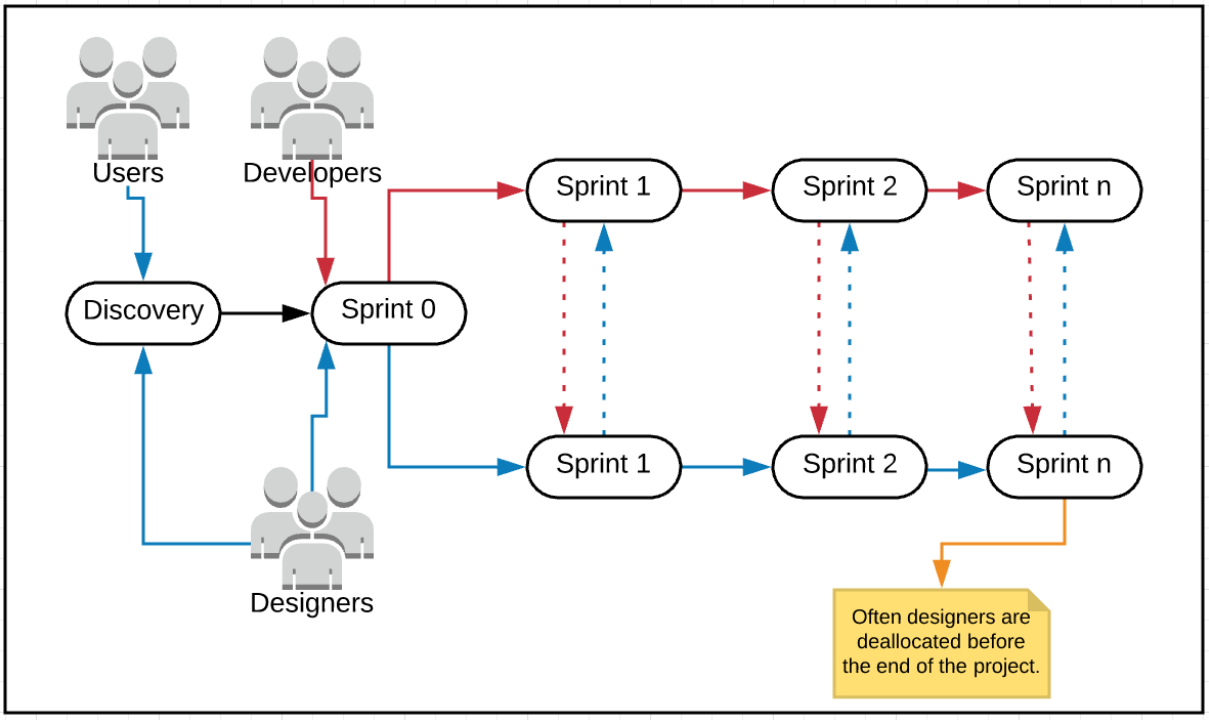

Figure 4-5. Representation of the work scheme in the organization E.

During the interviews we detected that the organization F has invested in the last years in the area of usability and user experience. The team's configurations are very similar to organization A and E, where two distinct departments (design and development) create multidisciplinary teams to work over a demand, as demonstrated in Figure 4-6. Today the organization has three designers available to work with the development teams. For each project that is being developed in the organization, they have at least one designer participating on it. The idea is to have multidisciplinary teams working together over the same problem. According to the interviewer their designers usually work harder at the beginning of the project to establish some patterns. After this phase they work hard to develop some usability tests. Because of this they usually work with the development team until the end of the project and eventually are deallocated before the end of the project.

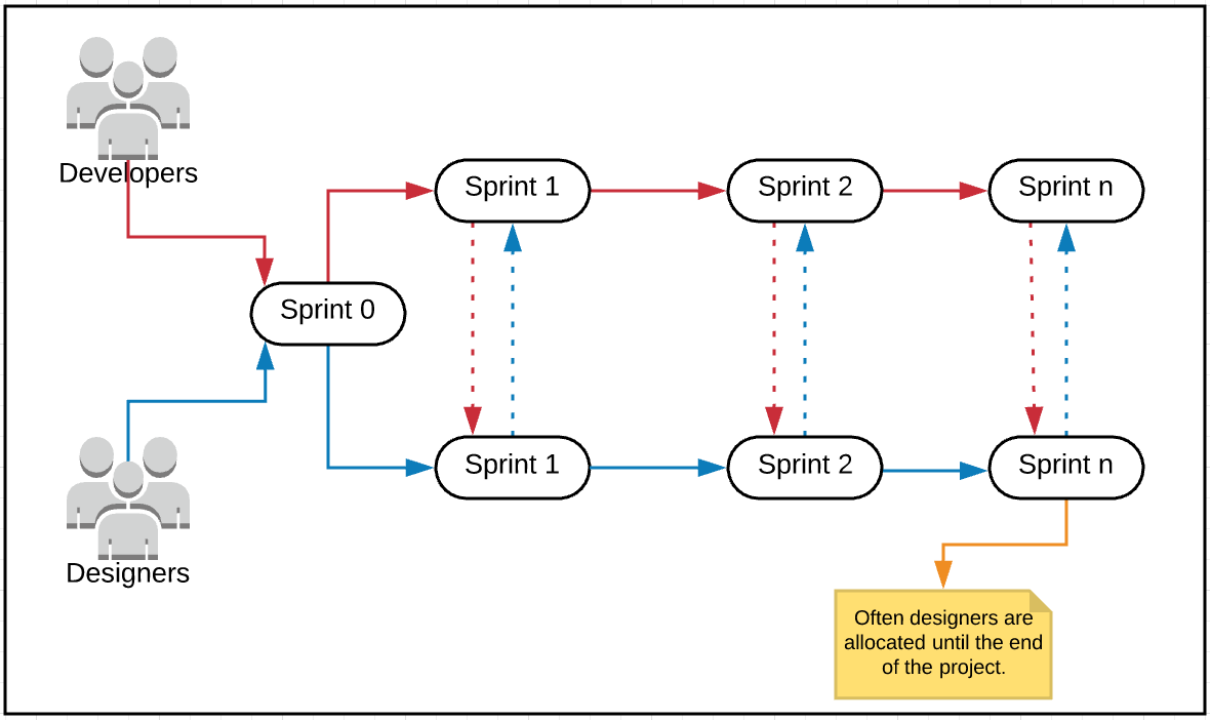

Figure 4-6. Representation of the work scheme in the organization F.

In organization G we could notice that the composition of agile teams is not always built with multidisciplinary profiles, including designer, UI designers, UX designers or web developers. This probably happened because the organization did not have inside of its team an employee to deal with specific issues related to usability or user experience. The strategy was to hire specialists outside the organization to work on specific projects that require more elaborated skills to develop the user interfaces. This work scheme was illustrated in Figure 4-7. Sometimes the clients ask for more usable interfaces and then a partnership is established with an external company to produce its specific contents or when a completely new project is started then the designer is involved in the project. Otherwise, their participation ends up being very punctual.

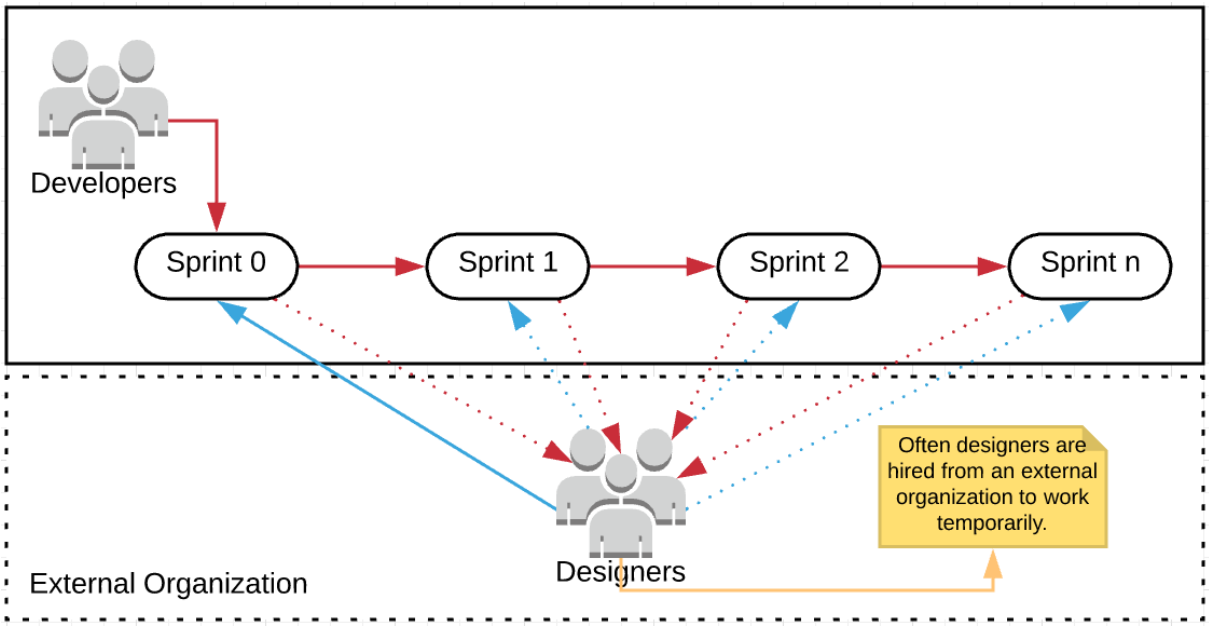

Figure 4-7. Representation of the work scheme in the organization G.

Practices and tools: during the analysis of the organizations, we found evidence of several tools that help designers in the integration of usability to the agile development approach. Most are tools for designing, prototyping, building mockups and wireframes. However, with respect to usability testing practices, little evidence was found. Most of the tests are informal, based on the knowledge of the professionals. Issues regarding time constraints for usability testing have also been reported as well as the lack of adequate knowledge and tools to explore this issue.

4.4 Considerations about this chapter

In this chapter we present the results obtained through the analysis of the case studies carried out. The conclusions obtained from these analyses were used as inputs to support the new approach proposed.

CHAPTER 5 - UXIAD – User eXperience Design Integration for Agile Development

This chapter describes a new approach, based on the analysis of the results of the case studies, as well as the models previously proposed in the literature review, that served as inputs to support it.

5.1 Initial Analysis

As already described by Salah, Paige and Cairns (2014) the focus of the agile development is not creating products with good usability. They are often focused on the core functionalities. With this in mind, the purpose of this work is to create an approach that can meet the agility requirements inherent to agile methodologies and frameworks, as well as to meet the needs of end users in terms of improving the user experience. Our research question is: **How to integrate usability with agile software development focusing on user experience?**

For this purpose, we propose a new approach to:

1. Present the **roles** needed to integrate user experience in agile environment;
2. Propose the adoption of new **artifacts** in this environment;
3. Discuss the introduction of some new **practices**.

In Chapter 2 of this thesis, six approaches have been presented that were previously proposed to integrate usability as well as issues related to user experience in agile software development. In Table 5-1 we compared the six approaches and presented the advantages and disadvantages of each one compared to the traditional Scrum development.

Table 5-1. Overview of the advantages and disadvantages of previously identified approaches.

	One Sprint Ahead	Dual Track	BOB (Best of Both Worlds)	Lean UX	Design Sprint	Lean Inception
ADVANTAGES						
Prioritizes UX and UI activities. (SALAH; PAIGE; CAIRNS, 2014)	✓	✓	✓	✓	✗	✗
Performs (prototype / product) assessments with end users including specific usability/UX issues. (SALAH; PAIGE; CAIRNS, 2014)	✓	✓	✓	✓	✓	✗
Generate some specific UCD / UX documentation. (SALAH; PAIGE; CAIRNS, 2014)	✓	✓	✓	✓	✓	✓
Reduces the burden on development team members (works with different profiles and roles). (SALAH; PAIGE; CAIRNS, 2014)	✓	✓	✓	✓	✗	✗
It works with the idea of creating an MVP in the initial Sprint. (RIES, 2011)	✗	✗	✗	✓	✓	✓
Approach based on Design thinking principles: 1-human-centered, 2-evolutionary, 3-context-oriented, 4-visual, 5-multidisciplinary (collaboration and co-creation), 6- holistic (BROWN, 2008)	✗	✗	✗	✓	✓	✓
Focus on eliminate Upfront Design	✓	✓	✓	✓	✗	✗
The approach embraces UX debits;	✗	✓	✓	✓	✗	✗
Prioritizes the validation of requirements before development to create an already validated backlog. (KNAPP; ZERATSKY; KOWITZ, 2016)	✓	✓	✓	✓	✓	✓

	One Sprint Ahead	Dual Track	BOB (Best of Both Worlds)	Lean UX	Design Sprint	Lean Inception
DISADVANTAGES						
The identification of new requirements or changes to existing ones may impacts the proposed approach. (KUUSINEN, 2016)	✓	✗	✗	✗	✗	✗
Teams may encounter problems with time, communication and design implementation due to the fact that they are working in parallel teams. (SALAH; PAIGE; CAIRNS, 2014)	✓	✓	✗	✗	✗	✗
The focus is not necessarily on developing applications with better usability or user experiences, but on validating the business before starting development.	✗	✗	✗	✗	✓	✓
The approach is focused on small teams, dedicated and collocated teams.	✗	✗	✓	✓	✓	✗
The approach is still little known by the market or is still restricted to a group.	✗	✓	✓	✗	✓	✓
Lack of published work with results collected from its use.	✗	✓	✓	✗	✓	✓

In Chapter 3 and 4 we presented respectively the research approach developed in this study and the results of the case studies. In Table 5-2 we list some of the main difficulties encountered during the analysis of the results of the case studies regarding the integration of issues related to usability and improvement of the user experience in agile software development.

Table 5-2. Mapping of associated difficulties resulted from the case studies.

1 - Lack of knowledge to deal with specific issues related to usability or user experience.
2 - Little evidence were found regarding to usability or user experiences tests. Most of the tests are informal, based on the knowledge of the professionals.
3 - Lack of clarity within organizations in defining the activities of an UI designer and an UX designer.
4 - Difficulties related to create and maintain multidisciplinary teams.
5 **-** The need to deliver value to customers in a short time is one of the main factors that lead companies not to apply usability practices in agile software development.
6 - Concern for better usability or user experience is often linked to a specific type of development platform.
7- Trends in developing software products using the Upfront Design approach and not breaking down into minimum viable products.

Based on the information that was gathered, the new approach was created and will be presented in the following section.

5.2 Proposed approach

The new proposed approach is called UXIAD - User eXperience Design Integration for Agile Development, which aims to integrate the user experience into agile software development. The proposed approach is based on an agile framework already consolidated in the market (Scrum). To make possible to integrate the concern with the end user experience with agile software development we decided to include specific roles, artifacts and practices allied to user-centered design approach to accomplish this research goal.

The UXIAD approach is composed by one only track separated by two distinct phases. The first phase is called “Workshop” which aims to gather developers, UX designers, users, clients and all kind of identified stakeholders, as demonstrated in Figure 5-1. This phase focus on identifying the users of the future product, their expectations, pains, the value aggregated to this new idea and mainly how to bring good experiences to them. The second phase is called “Development” which aims to

develop a minimum viable product, starting with an initial backlog and with validated ideas and prototypes. With this we aim to start developing viable and validated product, avoiding waste of money and time.

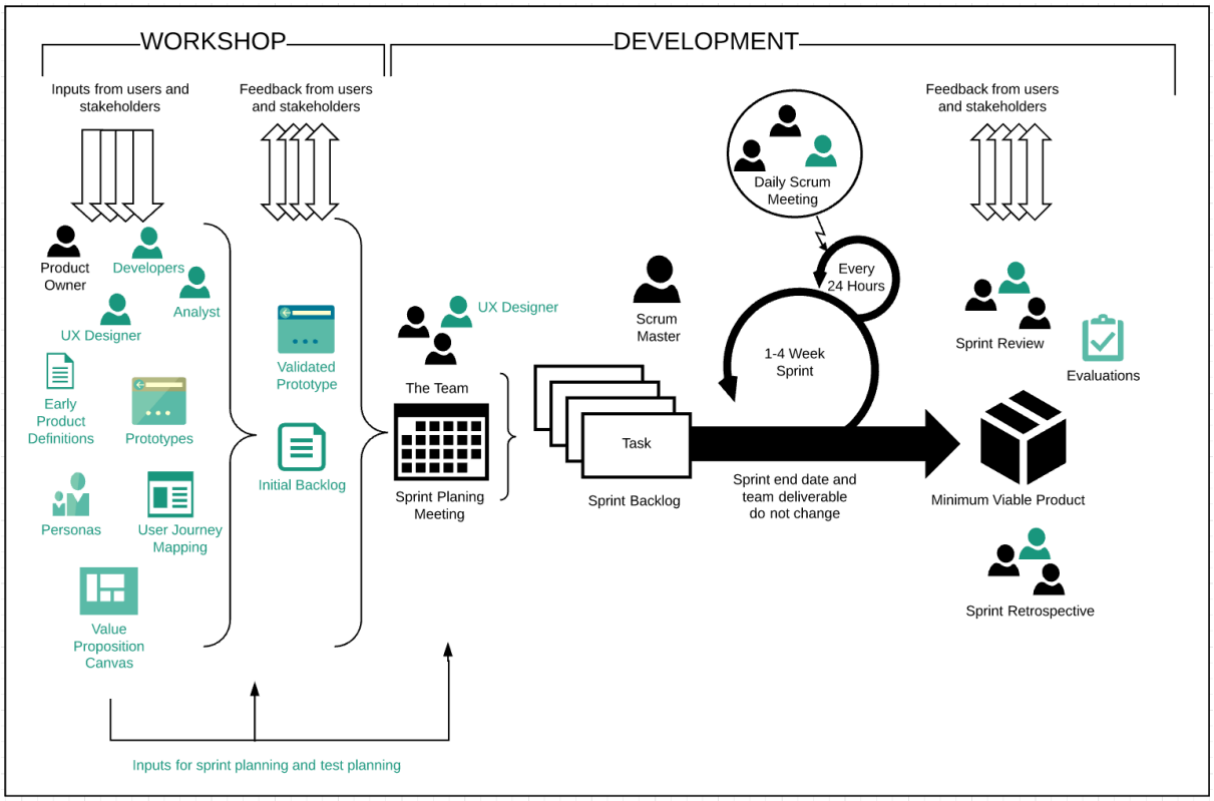

Figure 5-1. Representation of the UXIAD approach.

5.2.1 Workshop Phase

In the first phase of the approach, we included different types of stakeholders to identify different points of view and to enrich the final solution. With this, it was expected to decrease the possibilities of product fail. In this phase we used different artifacts as early product definition, personas, value proposition canvas, user journey maps, prototype and an initial backlog. Different from the known frameworks we included these artifacts because they are focused on identify the future users and their pains. Our goal is, at the end of this phase, to have an initial backlog, navigable prototypes to be validated by our clients and a vision of the minimum viable product before to start any kind of development. We want to avoid spending time and money in developing a solution that is not suitable for the final users or with a negative experience.

For completing these artifacts some steps were defined (empathy, definition, ideation, prototyping and testing) which were based on the double diamond model of Design Thinking, as shown in Figure 5-2.

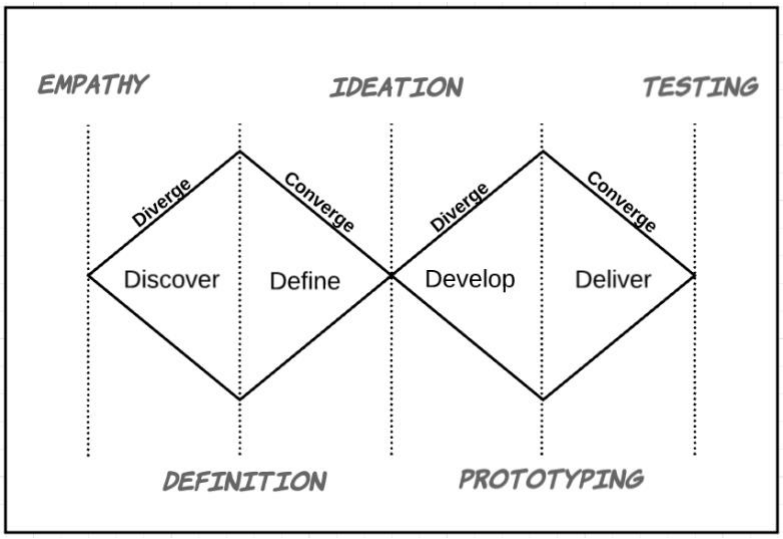

Figure 5-2. Representation of the Workshop steps based on the double diamond of Design Thinking.

5.2.1.1 EMPATHY

In this first step, the idea is to explore the problem to be solved and the users' information through empathy, which is related to the ability to understand the need of the other. It will be important to explore the discoveries and diverge the thoughts, in order to get deeper into the richness of the details of the activities carried out, especially in the pains reported by them. At the same time, it will be necessary to be aware of the identification of new opportunities for improvement and possible values that may provide an improvement in the final user experience. This item reinforces the importance of understanding the problem to be explored. In the representation of the UXIAD approach, the name Early Product Definition was used to represent this artifact that should be developed, but in order not to make this data collection rigid, some alternatives to be used are proposed.

In agile methodologies, the Early Product Definition is usually developed by a product owner, using the product vision artefact or a canvas. The difference in the proposed approach is that this artifact will be defined in a collaborative manner, involving different skills, including UX designers, developers, analysts, clients and

users. With this artifact is intended to capture succinctly what is the product to be developed, their initial requirements and what is expected to reach. The idea is to complete this artifact in a collaborative manner guided by a product owner. The participation of developers and UX designers are essential because they will develop new ideas that are not necessarily related to functional issues but non-functional desires.

The first alternative is the use of the artifact known as Business Model Canvas, proposed by Alexander Osterwalder (OSTERWALDER; PIGNEUR; CLARK, 2010). Through this artifact it will be possible to map the main activities to be developed in the new product or service, the necessary resources, the value proposal to be added, which customer segments will be served by this demand, which will be the relationships with the customers, which communication channels will be used and what will be the costs involved in the project and the main sources of revenue, as shown in Figure 5-3.

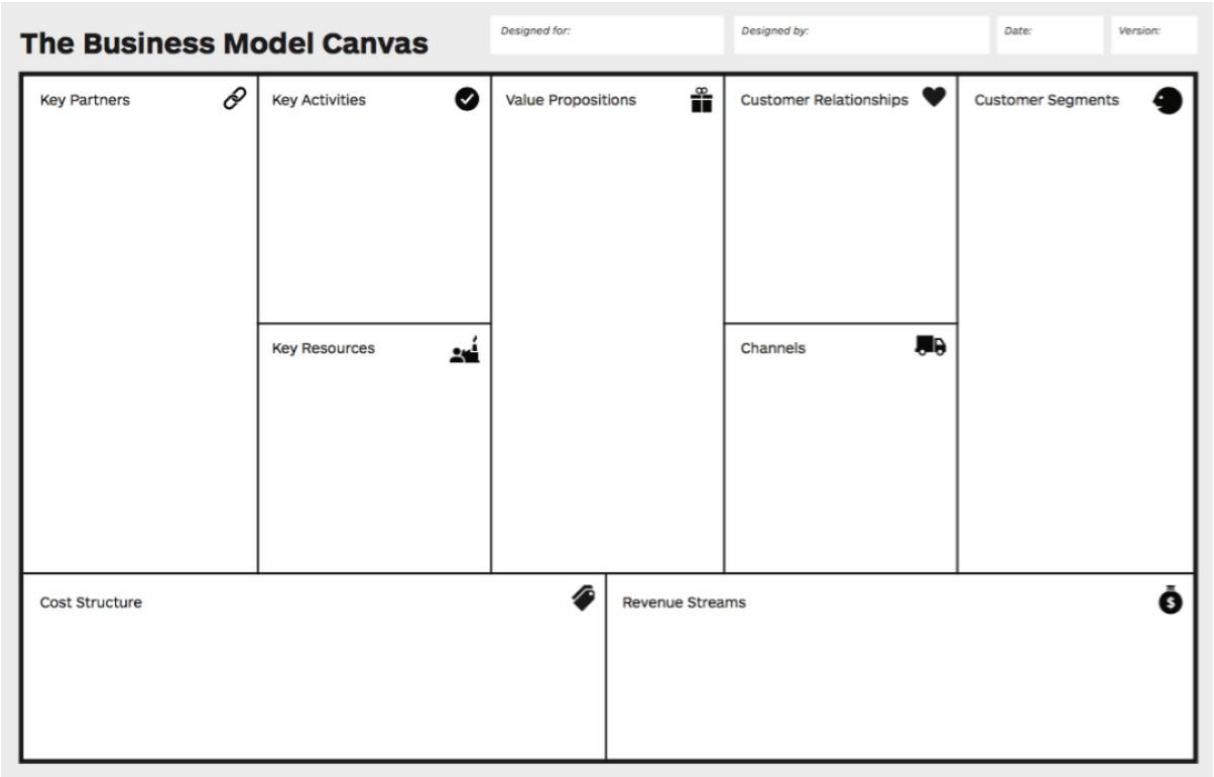

Figure 5-3. Representation of the Business Model Canvas.

Another alternative is to use a descriptive document, known as the Preliminary Project, where the main items are: business objective, main users and those involved in the project, a brief description of the current scenario, main problems reported by

users and customers, alternative proposed solutions and a brief study on the best alternative to be applied. Regardless of the artifact to be used or the technique that is applied, the important thing in this context is that the items in the documents identified above can be answered collaboratively.

At the same time that the early product definition starts to be created another important artifact will be used. It is proposed to be used the technique known as personas for the user's identification, as illustrated in Figure 5-4. As already presented in Chapter 2, personas are archetypical representations of customers or users that provide a portable data structure that allows all members of the development team to communicate and have a common base to which to refer (BROSCHINSKY; BAKER, 2008). It will provide a way to identify group of users or costumers in order to explore costumers need, goals and behaviors. This artifact helps the stakeholders to identify the future users of the product with more details. Instantiating a persona is known as a proto-persona and are our best guess as to who will use the product and why.

This identification will guide the development of the product as well as the final evaluations. The feedbacks of the final version of the minimum viable product will be captured by those identified personas.

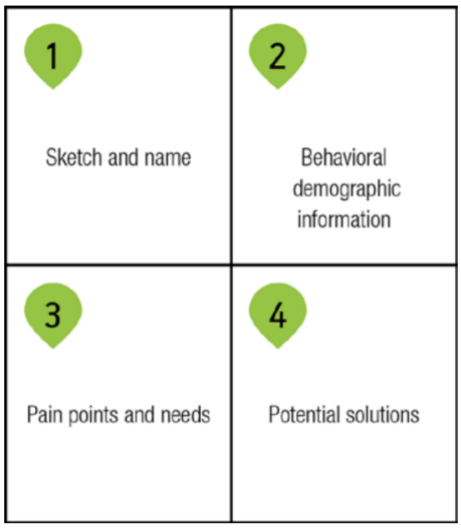

Figure 5-4. Blank persona template (GOTHELF; SEIDEN, 2013).

After that another artifact will be used, called Value Proposition Canvas (OSTERWALDER et al., 2014) that zooms into details of two of the building blocks, as shown in Figure 5-5, of the Business Model Canvas (OSTERWALDER, PIGNEUR, 2010): value propositions and customer segments. While the Business Model Canvas

helps you to create value for your business, the Value Proposition Canvas helps you to create value for your customer.

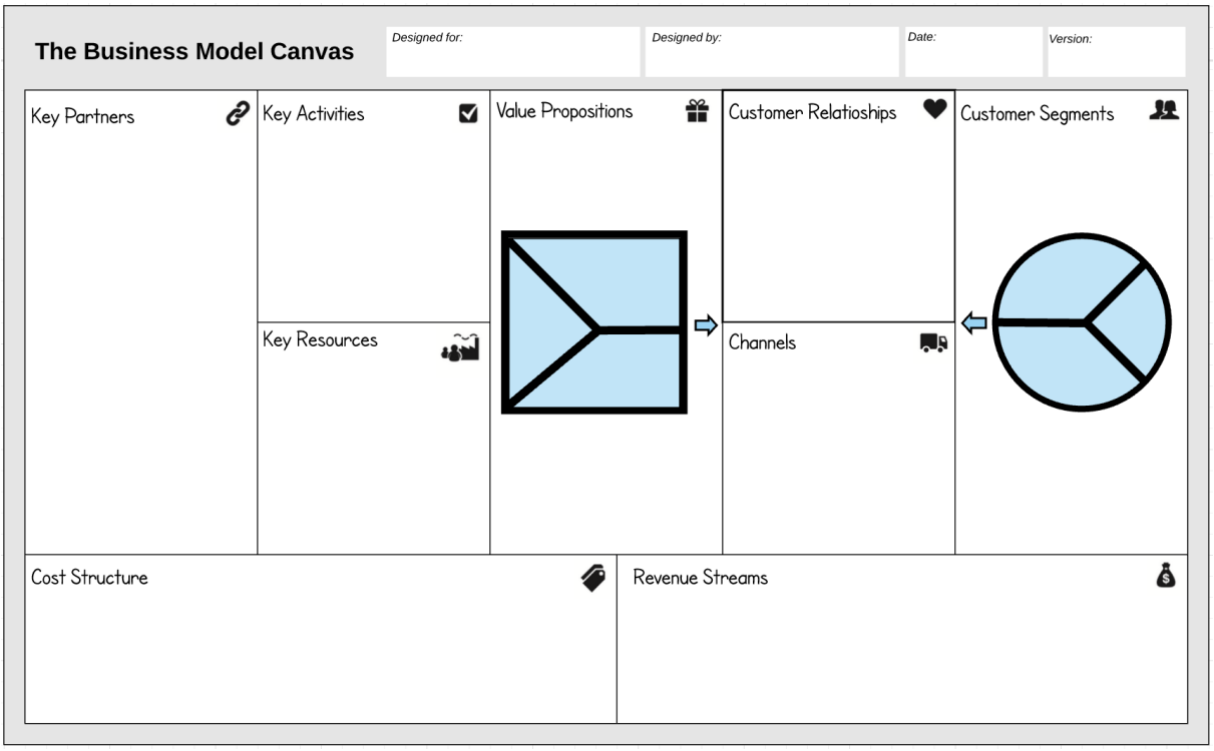

Figure 5-5. Example of the Business Model Canvas according to (OSTERWALDER, PIGNEUR, 2010).

The Value Proposition Canvas will help to clarify what are the jobs to be done, pains and gains of the future customers, through the customer segment block. On the other hand, the pains relievers, the products and services to be delivered and the gains will be studied more deeply, through the value proposition block, as demonstrated in Figure 5-6.

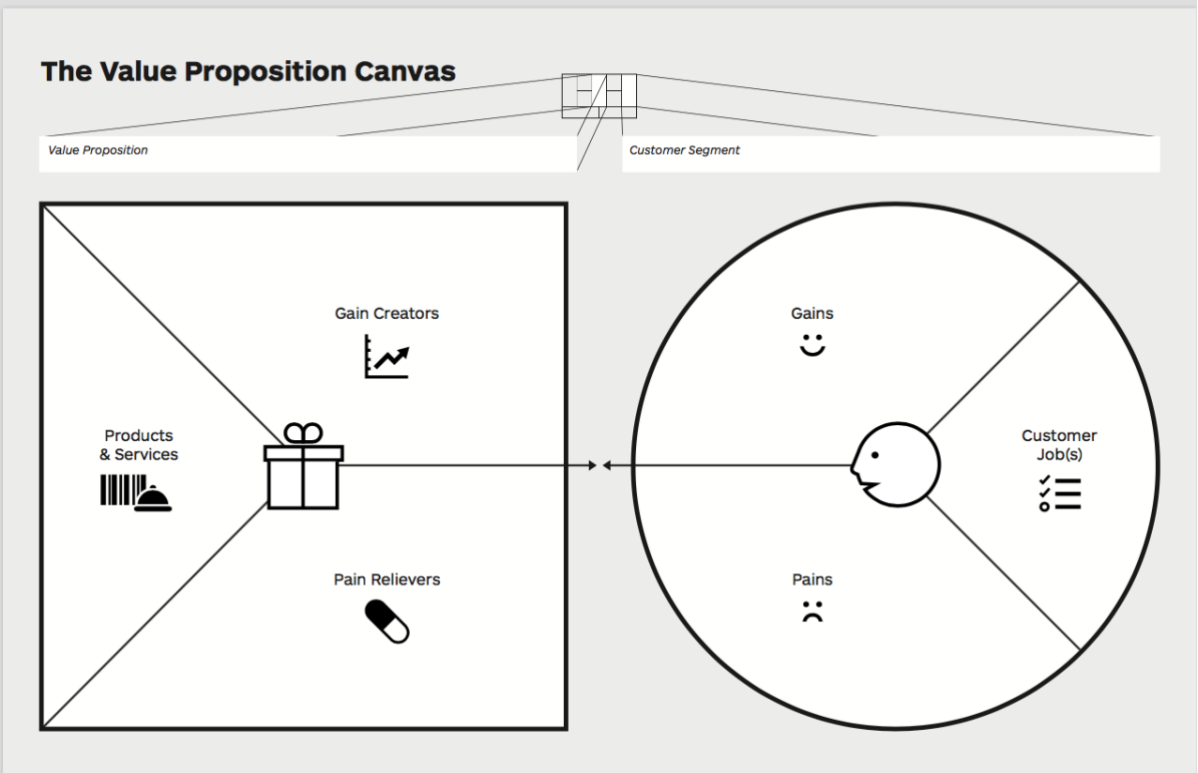

Figure 5-6. Example of the Value Proposition Canvas according to (OSTERWALDER et al., 2014).

In general, the value proposition will describe the benefits customers can expect from your products and services. So, to start the development of the Value Proposition Canvas is important to discover and map the personas and the target audience before. After that it is necessary to analyze the items presented on the **Customer Segment** profile that will describe a specific costumer segment in a more detailed way, breaking it down into jobs, pains and gains. In the Customers Jobs section is necessary to describe what customers are trying to get done in their work. In the Pains section is necessary to identify the risks, obstacles or bad outcomes related to the customer's job. In the Gains sections it is necessary to identify what are the concrete benefits or outcomes customers want to achieve or that are seeking.

On the other hand, the **Value Proposition** Map will describe the features in a more structured and detailed way breaking it down into products and services, pain relievers and gains creators. In the Products and Services section is necessary to identify the list of all products or services that this value proposition canvas is built around. In the Gain Creators section is necessary to describe how your products or services create customer gains. Finally, in the Pain Relievers section is necessary to describe how your products and services will alleviate customer's pains.

The idea is to achieve a fit between the value proposition map and your customer profile. So, it will happen when the products and services offered produce some pain relievers and gain creators that match with the identified jobs, pains and gains that are important to your customer. It is not necessary to come up with a pain reliever for every pain identified in the customer profile, the idea is to focus only on few pains that will alleviate extremely well. So, it is important to prioritize jobs, pains and gains, putting the most important jobs, most extreme jobs and essential gains on the top and moderate pains and nice-to have gains at the bottom, as represented in Figure 5-7.

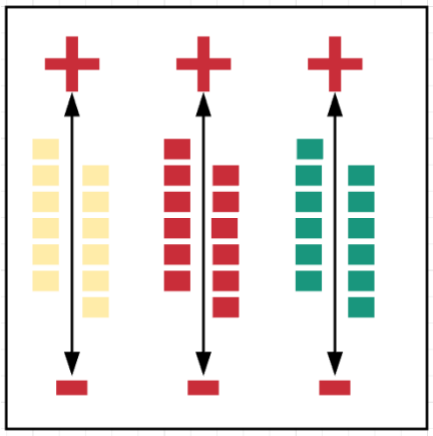

Figure 5-7. Representations of jobs, pains and gains prioritization according to (OSTERWALDER et al., 2014).

As represented in Figure 5-1, the idea in this phase is to discuss the whole product, but to deliver it in frequent iterations and small deliveries. So, with these proposed artifacts completed will be possible to identify what requirements and scenarios are essentials to be part of the minimum viable product. The idea is to identify those requirements that will impact the users and aggregate value to the final product.

To accomplish this goal, we propose for the next step to use the artifact known as "User Journey Mapping". The User Journey Mapping has its roots in “User Story Mappings” technique (PATTON; ECCONOMY, 2014) as the agile community usually recognizes it. According to (ENDMANN; KEßNER, 2016) the main difference between them is that User Stories Mappings aims to collecting core functions of the system under development and the User Journey Mapping is focused on learning about relevant user processes in order to identify areas with need for user research. The aim of using this artifact is to understand and address customer needs and pain points.

According to Kaplan (2016) the journey mapping combines two powerful instruments: storytelling and visualization. “They are effective mechanisms for conveying information in a way that is memorable, concise and that creates a shared vision”. A User Journey Mapping is generally divided into three zones: the zone A (the lens), the zone B (the experience), the zone C (the insights), as shown in Figure 5-8. The lens in zone A will provide the context for the map, identifying a persona (1) (who) and a scenario (2) to be analyzed (what). The experience in zone B will show the phases of the journey (3), actions (4), thoughts (5), and emotional experiences of the user through the journey (6). The insights in zone C will expose not only the insights but also to point out opportunities (7) as well as internal ownerships (8).

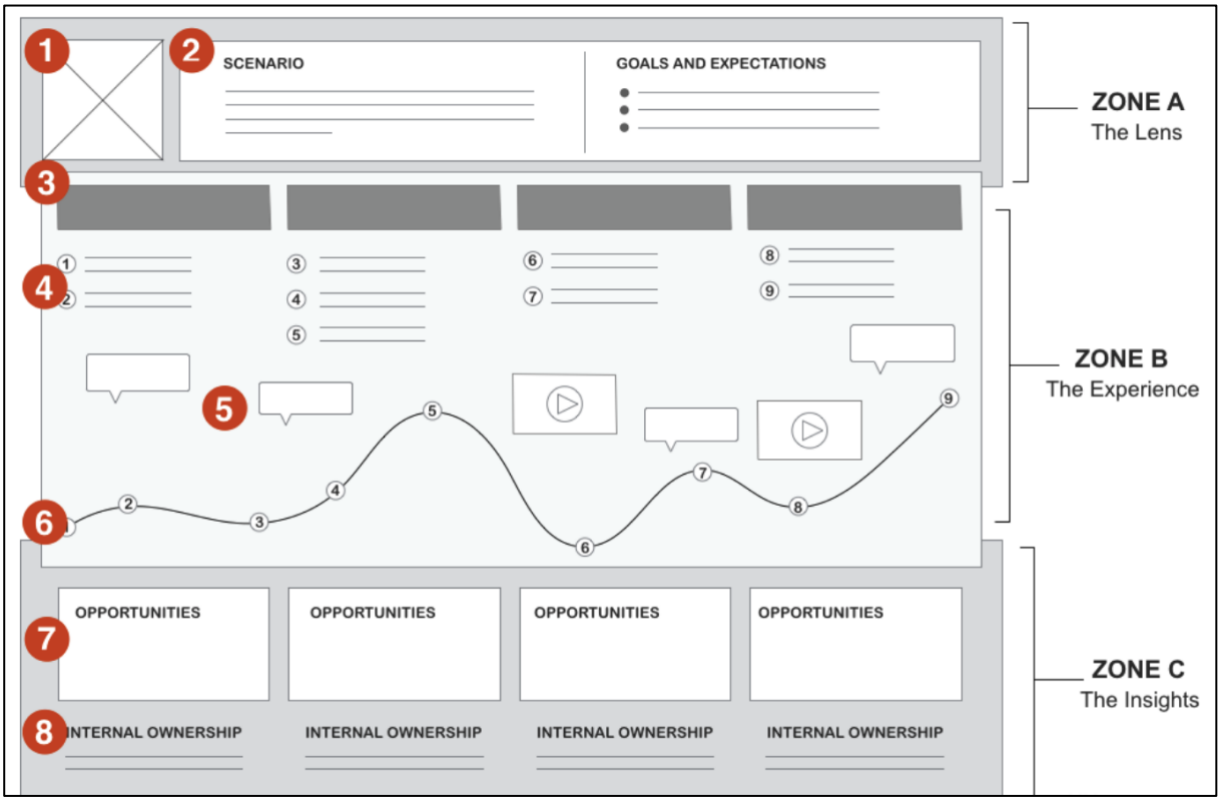

Figure 5-8. Example of a Journey Mapping artifact according to (KAPLAN, 2016).

The idea of the proposed approach is to include the use of this artifact already at the beginning of the design of the project, as a way of making the process of the user's journey known, understood and that mainly the pains and needs of the users are previously identified. Thus, this artifact can serve as a compass for the product owner, indicating priorities for the creation of the product backlog and sprint planning, as well as for the development team, in the planning and execution of the tests. It is

expected that zone B of the artifact, where users' pains and emotions are identified, will be used to reinforce tests areas and improve user experience.

5.2.1.2 DEFINITION

At this stage of the process, the point of definition of the final solution begins. It is the time, therefore, when the group as a whole must focus on converging ideas and thoughts in an attempt to reach a balance between costs and benefits of the final solution. With the completion of all the described artifacts, it is time to identify which values should be prioritized to really be attended by the solution. As previously explained, the idea is always to attack the painkillers that will solve the vast majority of the customers pains, and also which new ideas identified during the preparation of the users' journeys can be included in the final solution. From this, it will be evident to the customer the values that will be added to the final solution. It is suggested, at this point, to create a ranking of aggregated values to facilitate the visualization of the product development strategy.

Once the stage of preparing a ranking of aggregated values has been completed, the decision process on which will be the best alternative to be dealt with in the development of the solution must be initiated. Although it seems a very subjective step, the design of this strategy is very important, both for the project team and for the customers and users of the system. Although the suggestions usually come from the project team, the participation of the customer and users becomes essential at this point in the project. Here the entire strategy of the alternative solutions must be established and scored. In addition, it is important to start the artifact that we call the Initial Backlog. In this document the decisions regarding the added values and requirements that will be effectively met by the solution and must be delivered at the end of this phase, to the development team, must be documented.

5.2.1.3 IDEATION

After the conclusion of the alternative solution definition stage, a new stage of the Workshop phase enters, where everyone involved will again be able to actively participate in the ideation stage, co-creating the initial structure of what will be the final solution of the product or service. At this stage of the process, it is suggested that the team can effectively start the process of putting on paper the ideas that emerge to

define the interface of the product or service solution. Here, it is suggested the exploration of new ideas and a strong collaboration of the team, as this will not be an attribution of the UX Designer, but of all participants of the Workshop. It is also suggested that during the initial discussion the ideas that emerge are documented, using the concept of mockups or sketches, with pencil and paper in hand. The important thing here is to use the definitions of the alternative's solutions completed in the Definition step. With this will be possible to design the solution already based on the desired platform being it mobile, web, desktop or etc.

Once the mockups co-creation activity is finished, it is time to discuss and choose one of the alternatives that may have been delivered. From this selection will be possible to move on to the next stage of the process: prototyping. Here, the participation of the system users is really essential to avoid future re-development and an additional cost for the project. One of the objectives of the proposal of this approach is also to avoid rework, avoid increasing costs and also avoid developing a solution that may not be used by the customer.

5.2.1.4 PROTOTYPE

After the completion of the mockups and the definition of flows to meet the functional requirements of the project, it is time to create the navigable prototypes. At this stage, participation and knowledge of the user experience design is very important, as aspects of the interface design will be discussed and should be screened by the end user. Therefore, it is important that this professional has notions and knowledge in the area of graphic design, usability, typography and navigability.

5.2.1.5 TEST

With the navigable prototypes finalized, it will be necessary to validate it with the customer and with the users of the new solution. In this approach, we first propose to use the Elevator Pitch technique to make a brief presentation of the solution as a whole. This term Elevator Pitch refers to the idea of a brief and objective dialogue in which an idea of a product or service is presented, its main values and benefits, in order to arouse the interest of the interlocutor. In the context of this approach to the execution of this presentation, it is necessary to schedule a meeting, if possible involving users and those involved in the solution, so that the prototypes can be

presented and validated. In summary, from this presentation it should be possible to demonstrate:

- The purpose of the solution;
- Main customer pains;
- How the solution will cure these identified pains;
- What are the main gains;
- Presentation of prototypes;

After the initial presentation of the Test step, those involved in the process, including future users, should test and validate the navigable prototype. At this stage, the project team must follow the validation process, and through observation, should capture any flawed points regarding non-functional requirements as well as any considerations regarding functional requirements. The sooner these aspects are identified, the less re-development and less future expenses will be required. The sooner errors are caught, the sooner they can be remodeled and corrected. After conducting the tests together with those involved in the client and users, this can be considered, one more step closed. At this point, it is proposed, in addition to gathering all the documentation produced so far, to finalize the initial backlog artifact, which should also be pre-validated by users and interested parties in order to generate a minimum viable product.

Only after the completion of this activity, with the initial requirements and prototypes validated by customers and interested parties, can we move on to the next phase, called Development. Once again, if problems are identified in the backlog with the survey of non-functional requirements, these should be corrected and forwarded to the development phase.

5.2.2 Development Phase

5.2.2.1 Kick OFF – Sprint Planning Meeting

It is time to gather the material produced in the previous phase (the early product definition, the identified personas, the value proposition canvas, the user journey maps and the validates prototypes) and carry out the solution development planning.

It is during the kick-off meeting that all planning must take place, including the development environment, tools, packages and delivery schedules. The following are the activities that should occur.

5.2.2.1.1 Preparing the environment

It is important to understand that for the start of development it is necessary that the entire development environment is prepared. This includes creating the environments, as well as installing tools for development. In the pure context of Scrum, it is suggested that the development team, whenever possible, can remain physically close, so that iteration and communication take place continuously, easily and quickly. It is therefore suggested that daily follow-up meetings (known as daily meetings) be held, where the status of ongoing activities will be raised, what impediments may be occurring and which need Scrum Master intervention, and which will be the next activities to be carried out and distributed.

5.2.2.1.2 Receiving the prior artifacts

After preparing the environment it is very important that the development team receives the artifacts that were generated in the previous steps. In this way, it is possible to carry out the planning of activities.

5.2.2.1.3 Understanding the priorities

Usually at Sprint planning meetings, the Scrum Master assumes the responsibility, together with the Product Owner and the development team (including UX Designer), to organize the activities, always in releases that can be developed within a week or two (timebox), thus guaranteeing continuous deliveries, with always very close monitoring of those involved (users). It is important to emphasize here that the idea is always to focus on the development of a minimum viable product. Having this thought in mind is very important for prioritizing the activities that will be developed.

5.2.2.1.4 Defining the deliveries – Sprint Backlog

As a result of the Sprint planning meeting, it is expected that the backlog of activities raised in the Workshop phase will be organized in smaller packages, so that the development team can start its activities.

5.2.2.2 Sprints Development

In the following steps, the activities that should be developed during the sprint development stage will be described.

5.2.2.2.1 Developing the product

After the Sprints planning meeting and the definition of the delivery packages, it is time to start developing the solution. During the iterations (sprints) it is also expected to involve the role of the UX designer, not only helping to define the priorities, but also providing complementary insight on how to obtain better user experiences from the critical pain points raised in the user journeys maps, attending daily meetings, sprint review and sprint retrospective.

The idea here is that the development of the interfaces is carried out by the UX Designer, as this role can focus on the issues of typography, colors and usability with a focus on developing solutions that will provide a better user experience. Therefore, the product will be developed in two layers: front and backend. Developers will be responsible for the development of the backend layer.

5.2.2.2.2 Focusing on Minimum Viable Product

As previously reported, the focus of package delivery is on meeting a minimum viable solution. This facilitates the monitoring of the project by the customer, who will have the opportunity to be constantly validating what is being delivered. For each completed Sprint, it will be important to hold the Sprint Review meetings (Sprint Review) with the customer, to validate whether the product requirements (backlog) for that Sprint have actually been completed, focusing on delivering a minimum viable product.

5.2.2.2.3 Lessons Learned - Retrospective

It is also suggested that, in this approach, Retrospective Meetings (Sprint Retrospective) be held at the end of each Sprint so that it is possible for the team to discuss possible improvements in the process, validate practices that may be bringing an individual gain and that can be shared with the team, as well as drawing up plans to correct flaws in the way the team works. This retrospective identifies the possible lessons learned by the development team. It is important to keep this learning history on record, as it is possible to create a base that can be passed on to future project teams. Thus, a way of working with constant improvements is established, guaranteeing a better quality in the work developed.

5.2.2.3 Evaluations

The following step will describe the activities that should be developed during the evaluation stage.

5.2.2.3.1 Conducting Test

In this stage, it is intended to assess whether the pains identified in the Empathy stage and planned to be performed in the current Sprint, were implemented and remedied in order to meet the needs of users. The idea is to involve system users in solution approval sessions and based on observation, document steps or comments that system users may make. As demonstrated in Table 5-3, a checklist structure is proposed to evaluate the result of each Sprint.

Table 5-3. Checklist proposed to evaluate each Sprint.

Pain Points	Requirements *Backlog*/Painkillers	Package/ Sprint	Observation	Accomplished
1)	1)	1)		
2)	2)	2)		
3)	3)	3)		

Our intention is to use the artifacts: value proposition canvas and user journey maps to be validated at the end of each delivery. With them will be possible to verify if the wishes of customers, users and stakeholders in general were met by the solution.

In this way, we proved that the pain points identified on the value proposition canvas in the beginning of the process were explicitly remedied and that the user had a good experience as a user of the product.

The experience zone (B) and the insights zone (C) of the user's journey maps will be also used as references to test if the pain points identified and exposed were treated and also if the opportunities were explored to obtain better user experiences. If irregularities or improvements are identified, they can enter a next Sprint, to be dealt with by the development team with the help of UX Designers.
It is expected that, at the end of the software development, the solution will be evaluated, as a whole, based on partial evaluations (deliveries). It is believed that constant communication between the development team and users can facilitate and help in the work of improving the end user experience with the product developed.

5.3 Considerations about this chapter

In this chapter we presented the new proposed approach UXIAD - User eXperience Design Integration for Agile Development. We believe that the proposed approach can be used useful to facilitate the integration of user experience design in agile development. It focusses on defining roles, artifacts and practices to produce minimum viable products focused on better user experiences.

CHAPTER 6 - EVALUATION

This chapter presents the results related to the evaluation of the UXIAD. First, we will demonstrate the characteristics of the environment in which the approach was evaluated as well as the results of the usability tests. Next, we will demonstrate how the evaluation of UXIAD was conducted with the overall goal of analyzing its applicability of the new proposed approach from two different points of view: the end users, and the work team involved with the use of UXIAD.

6.1 The researched scenario

UXIAD was evaluated by an organization that uses the agile methodology (SCRUM). Aiming to formalize the research and to have the correct permissions to run the research protocol, two documents were sent to the organization: the cover letter, presented in APPENDIX L and the non-disclosure agreement presented in APPENDIX M.

After obtaining the necessary permissions, it was also necessary to select a project that met the requirements necessary for proper evaluation. When a project was found, it was also necessary to obtain authorization from the organization's customer to execute the research project. For this, the same two documents presented in APPENDIX L and APPENDIX M were also sent to the organization's customer and the authorization to execute was issued.

The selected project was intended to replace a system currently in use by customers and despite having only two users allocated in its use, meets the demands of several customers. The whole application was estimated in 595 function points to be developed in 15 months. Due to the deadlines for the completion of this doctoral thesis, it was decided to focus on the results of the first module, which was considered the heart of the system.

The work team allocated was composed by 3 people developing the following roles: analyst, user experience designer, scrum master, product owner, developer, project manager. A fourth analyst was also assigned to the project, but he did not

participate in the entire process. It was only allocated in a few application developments sprints, but it played an important role in the survey to get feedback on what really goes on in the day-to-day of a development project. The next section will describe the evaluation phases and the results obtained.

6.2 Running the Workshop Phase

In the workshop phase, several meetings had to be held so that it was possible to collect the necessary data and also to complete the proposed artifacts. As the beginning of this phase coincided with the period of the COVID-19 pandemic (April of 2020), we had several communication problems. The team had to adapt to the period and all work, during this stage, had to be carried out remotely, which made communication a little difficult but did not hinder the progress of the solution. We decided to run small meetings, every day at 9:15 AM, to work on this project.

Firstly, we started the **empathy step** by creating the preliminary project artifact, with all the contextualization of the current solution in use and also the requirements that should be met in the development of a new solution. To have an easy and fast artifact to use as an input for the group, a Business Model Canvas, presented in APPENDIX N, was also created to help the visualization and discussions by the group.

During the requirement analysis the team involved in the workshop phase also created the personas presented in APPENDIX O, the value proposition canvas presented in APPENDIX P, and the user journey maps presented in APPENDIX Q.

After that, we started the **definition step**, when the idea to solve the vast majority of the customers' pains were discussed and prioritized. We also included in this discussion the new ideas and opportunities identified during the development of the users' journeys maps. We also started to create an initial backlog to be evident to the customer the values that will be aggregated to the final solution. We then used a specific plugin for agile projects installed in a tool called Mantis. This tool is known by the companies because it is a bug track tool. But in this project, this specific plugin made it possible, as presented in APPENDIX R.

As we finished it, we started the **ideation step**, where the team could co-create the initial structure of what would be the final solution. At this stage of the process, the team started to put on paper the ideas that were emerging to define the interface of the product. As we did not have an official tool to perform co-creation meetings, the

UX Designer started the initial discussion using sketches, with pencil and paper in hand. We also used some tools provided by the company itself to perform the meetings, but as we were at the beginning of the pandemic period, often the overload on the servers made these tasks very slow. So, we decided to use the Google Meeting tool to perform it. In this moment we decided to advance for the next stage, the **prototyping step**, to facilitate the communication and the co-creation process. The UX Designer developed the initial version of the prototypes, as presented in APPENDIX S, using an available tool in the company (Axure). This tool allows the prototypes to be published in a cloud and made available for the team to access it and discuss the solution. Many suggestions and contributions were accepted, and in a co-creation process, the prototypes were adapted to become better. This publication made possible for the team go to next stage, **the test step,** to present and discuss with the customers the solution and define the best alternative to be developed. Here the UX Designer presented the purpose of the solution, the main customer pains, how the solution will decrease these identified pains and what are the main gains proposed by the prototyped solution. The role of the user experience designer in this phase was fundamental, as his knowledge in this area favored the development of new ideas and patterns in the prototypes.

This phase took a little more time that we have expected. From April to July of 2020 all described artifacts were completed and as the idea of this product was to develop a scalable solution we had to test and validate it with different possible customers. At the end of this stage, all the scenarios raised in the users' journey maps were validated with the customers. Some adjustments had to be made due to business rules, but it was possible to have the validation that the project was on the right track.

6.3 Running the Development Phase

After the conclusion of the workshop phase and the validation of prototypes with customers, we effectively started the development of the project.

With the start of the project, the scrum master performed all the registration of user stories, identified by the backlog document generated in the previous step, in an agile plugin available in the Mantis tool. The work started with a **kickoff meeting**, where activities for the first sprint were organized. The sprints were organized to be carried out in a period of two weeks, where the first day would always be reserved for

the organization of the activities of the sprint and in the last two days the usability tests would be carried out in the system, as well as the review and retrospective meetings.

After this, we also had to **prepare the environment** to start the development, and also to adapt to the new situation, as it was necessary to maintain the remote access available. Since the beginning of the pandemic period, the organization had to quickly adapt and provide remote access to the organization's development environment. So, the analysts continued to access their personal computers at the company via virtual private network (VPN). The programming language chosen for the project was PHP using the Laravel framework and PostgreSQL database. Git was used as a repository for the project. Daily follow-up meetings were set to happen at 9:15 AM to verify the status of ongoing activities to be raised, impediments that might be occurring, and what were the next activities to be carried out and distributed. With all necessary environment aspects in place, the team **reviewed the documentation initially** carried out and then set out to **define project's priorities**. In this case, it was decided that the functional identification module would be prioritized, as it was necessary to replace the old system, perform the necessary data migration as the current responsible for the system is about to retire. It was necessary to make an effort to analyze the currently information available in the old system, so that the new system could be thought out and modeled to receive the legacy data. It was critical and necessary for the customer that the legacy data was migrated securely. After identifying the priorities, the **first Sprint were set,** and the development team was prepared to start the activities.

6.3.1 Running Usability Tests

To develop the whole solution a period of 18 months was necessary. During the product development, due to the reduced development team, it became evident that it would not be possible to have a deployable product to execute usability tests at each end of Sprint. Because of that, we also had to re-adapt the usability tests, which also ended up not happening in all Sprints. A total of 4 usability tests were performed, always with the two available users of the current system as described on the Table 6-1.

Table 6-1. Calendar of developed usability tests.

Id.	Sprint	Sprint Period	Test Date	Goal	Location
1	Sprint 3	12/11/2020 to 26/11/2020	25/11/2020	Perform the usability test in the "Maintain Seal" module.	Presential test
2	Sprint 7	29/01/2021 to 12/02/2021	01/02/2021	Perform the usability test in the “Maintain Funcional Identification Card” module (for active servers).	Presential test
3	Sprint 12	16/04/2021 to 30/04/2021	27/04/2021	Perform the usability test in the “Historic” and “Print of Functional Identification Card” modules.	Remote test
4	Sprint 13	03/05/2021 to 17/05/2021	11/05/2021	Perform the usability test in others functional identification card printing scenarios.	Remote test
5	Sprint 13	03/05/2021 to 17/05/2021	13/05/2021	Perform the usability test in others functional identification card printing scenarios.	Remote test

It was decided that usability tests would be carried out at the end of each module, as users had many activities to be developed in their work environment, which made it difficult to carry out more frequent tests. There was a gap between the first test and the second one as we also had to adapt the calendars to the employee's vacation period (December and January).

The first two usability tests were carried out in person, at the customers own workplace. The system was made available in an approval environment and access keys for the two users were made available for testing. The other tests that followed could not be carried out in person due to a State Decree that did not allow face-to-face meetings or gatherings to avoid the dissemination of COVID-19. To adapt to this period, we performed the tests remotely using a corporate tool (Webconf) that allowed screen sharing and also the use of a webcam. We also asked for customers’ permission so that the tests could be recorded.

6.3.1.1 First Usability Test

To run the usability tests some documentation needed to be previously prepared to represent the scenarios that needed to be tested. Before starting the usability test all necessary documentation was provided for the users to complete the test. The goal

of the usability test was to check requirements of this first module in terms of efficiency, effectiveness and user satisfaction. For the first usability test, four tasks were planned, and the results are summarized in Table 6-2.

Table 6-2. Summary of the first usability tests.

Task 1	Find and access the use case “Maintain Seal” in the dashboard after receiving an official document enabling an employee, for a specified period, to the position of police chief.			
	Planned Time	**Executed Time**	**Effectiveness**	**Efficiency**
User 1	15 s	1:25s	×	×
User 2	15 s	2:10	×	×
Execution Results	In this case both users did not complete the task. The evaluator had to intervene, after a few tries, and explain what the activity was needed to be performed. As this functionality was not presented in the current system, the users had difficulty to understand what was expected in this task. The person responsible for conducting the tests did not use the term "Seal", otherwise the option would be very obvious in the access menu. The word used was “signature”. After the clarifications provided, users tried again to execute the activity, which was performed successfully. As users made few unsuccessful tries, which led them to incorrect screens, there was a need to change the color pattern of the back button to blue, thus facilitating its visualization and leading the user not to use the browser’s back button.			
Task 2	Execute the registration of a new seal.			
	Planned Time	**Executed Time**	**Effectiveness**	**Efficiency**
User 1	1:15 s	0:50 s	✓	✓
User 2	1:15 s	1:07	✓	✓
Execution Results	Both users completed the task within the estimated time. User 1 took a little more time to enter the date. The keyboard and mouse cursor were used for insertion and had to arrange the dates due to the mouse positioning in the month/year field. None of the users have verified the end date – it was suggested to create a dialog box informing the conflict of dates and ask the user to confirm, when an overlap occurs. This information can only appear if there is a coincidence of dates and also when you click on the “Gerar Chancela” button. Users suggested that when registering the seal, it was also possible to upload the photo of the responsible person being registered to facilitate the data verification process.			
Task 3	Verify the existence of a previously registered seal within a certain period.			
	Planned Time	**Executed Time**	**Effectiveness**	**Efficiency**
User 1	0:25 s	0:06 s	✓	✓
User 2	0:25 s	0:10s	✓	✓
Execution Results	Both users completed the task within the estimated time. Users did not take into account the verification of the dates presented in the grid after the research was carried out, they were just taken directly to the icon that allows the correct visualization of the registered seal.			

Task 4	Delete a specific registered seal.			
	Planned Time	**Executed Time**	**Effectiveness**	**Efficiency**
User 1	15 s	25 s	✓	×
User 2	15 s	10s	✓	✓
Execution Results	Both users completed the task, but User 1 did not complete it within the estimated time. The User 1 took a little more time because before completing the exclusion, the name and seal of the specific register were confirmed in the document delivered. As the trash can icon was enabled for all records, this may have led the user to doubt, since seals previously registered and used in the system cannot be deleted. In this case, the suggestion is that the trash icon is only enabled for the most recent record.			

After completing the tests, with the pre-established scenarios, some adjustments were requested by users in general. Users were a little confused on the home screen and requested the inclusion of a grid, on the home screen, below the search parameters, to facilitate the progress and understanding of the activities available.

The main difficulty found in this module was precisely in the registration of the seal, as this step is not performed in the current system. Therefore, this functionality is a facility that was included in the process of making the functional identification cards, so that employees no longer have to obtain the signature of the general delegate in person. This process is time consuming and often impacts the delivery time of the wallet, as it is only carried out once a week, usually on Mondays.

To assess the user's satisfaction with the tested module, a Likert scale was established (totally unsatisfied, unsatisfied, neutral, satisfied, totally satisfied). Both users were satisfied with the module. Although they had some initial difficulty with the new features presented, almost all tasks were completed within the estimated time. This led us to believe that in terms of usability the module in question perfectly meets the established requirements.

6.3.1.2 Second Usability Tests

In this test, one scenario was elaborated that aimed to make the request for the first copy of the functional identification card. In this scenario, 4 steps are necessary: access the initial dashboard screen, access the integrated data visualization screen, filling out the form, finalizing the request and sending it to print. The results are summarized on Table 6-3.

Table 6-3. Summary of the second usability tests with the first scenario.

Step 1	**Request the first copy** – DashBoard- In this step, the user should use the menu "Carteira Funcional" and then register a new request.			
	Planned Time	**Executed Time**	**Effectiveness**	**Efficiency**
User 1	25 s	0:40s	×	×
User 2	25 s	0:29s	×	×
Execution Results	User 1 got confused and used the identification number provided to perform a search in the field available on the first page of the dashboard. As no record was found, the user did not know what action to take as next step. The user should ignore the form presented in the first page and should access the menu "Carteira Funcional" to register the new request. So, it was not possible to finish the task. User 2 also got confused and used the identification number provided to perform a search in the field available on the first page of the dashboard. As no record was found, the user did not know what action to take as next step. Both users, when starting the search from the initial screen, were unable to complete the proposed activity and the evaluator had to intervene. In this scenario, the need to plan an initial grid was evident so that users could, from an initial search, initiate other requests. This small change would facilitate the execution of activities performed by users.			
Step 2	**Request the first copy** – In this step, the user should confirm the data provided in the memo and after the conference should move on to the next step.			
	Planned Time	**Executed Time**	**Effectiveness**	**Efficiency**
User 1	0:20 s	0:10 s	✓	✓
User 2	0:20 s	0:05 s	✓	✓
Execution Results	User 1 confirmed the data that was provided in the memo and with the screen data. As the data visible in the system was compatible with the data provided in the memo, it was possible to identify the person and proceed with the registration. User 2 did not confirm the data with the ones in the memo, as it was possible to recognize the person by using the photo. This allowed the completion of the task and advanced to the next step. As in this step, not only the biographical data, but also the biometric ones (photo) are loaded, this greatly facilitated the process of identifying the data. A suggestion made by one of the users was to put the mask on the ID. This information will be highlighted and would facilitate the information conference.			
Step 3	**Request the first copy** – In this step, the user should fill in the registration information of the request.			
	Planned Time	**Executed Time**	**Effectiveness**	**Efficiency**
User 1	3:15 s	3:25 / 0:30 s	✓	×
User 2	3:15 s	2:13 / 1:25 s	✓	✓
Execution Results	In the first time, User1 did not inform all data that was requested on the screen, as was informed at the beginning of the test that if the user did not have the information it would be possible to proceed.			

<table>
<tr><td></td><td colspan="4">The insertion of “xxxxxx” in the e-protocol field by user 1 when registering the request did not allow the test to proceed. However, there was no error message to make it clear to the user which field would be corrected.
The evaluator had to intervene and explained why this error was happening. So, another test was performed and then the User 1 could complete the task.
User 2 was given the same information to fill in the fields, but they were ignored and only the mandatory fields were filled in to complete the task. In the second test, using her own data and after knowing how the system worked, the user entered the data and managed to register below the estimated time.
Some changes were suggested by users on this screen. Removal of the “Social Name” field - as users understand that it is not necessary to include this information at this time, insert the ID mask and see the possibility of adjusting the phone mask to 8 digits.</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td>Step 4</td><td colspan="4">Request the first copy – In this step, the user should access the print screen and after checking the data in the print queue, access the option to preview the functional identification card.</td></tr>
<tr><td></td><td>Planned Time</td><td>Executed Time</td><td>Effectiveness</td><td>Efficiency</td></tr>
<tr><td>User 1</td><td>1:00 s</td><td>1:23 s</td><td>✓</td><td>×</td></tr>
<tr><td>User 2</td><td>1:00 s</td><td>0:25 s</td><td>✓</td><td>✓</td></tr>
<tr><td>Execution Results</td><td colspan="4">User 1 did the correct verification of the data that was being released for printing and was able to find the option to verify the print preview. User 1 only took longer to verify but managed to complete the task successfully.
User 2 also did the correct verification of the data that was being released for printing and but did not access the print preview option.
Users confirmed in the check box which requests should be printed. Then they managed to generate a batch because the button was not enabled until the user selected an option. At this point it was clear to the user which activity should be performed.</td></tr>
<tr><td colspan="5"></td></tr>
</table>

In general, the tests were performed by both users, but user 1 took a little longer to execute the activities. We believe that as the entire process was redesigned, this may have caused an initial difficulty, but once understood, the process was overcome. Only the first activity was not completed by both users and in this case system changes should be made available as soon as possible. To assess the user’s satisfaction with the tested module, a Likert scale was established (totally unsatisfied, unsatisfied, neutral, satisfied, totally satisfied). Both users were satisfied with the module.

6.3.1.3 Third Usability Tests

The third test performed was aimed at testing the usability of the history module and the print module. The first one will have historical data (legacy) being loaded, as well as the possibility of insert, edit or delete information. As the third test had to be performed remotely, the scenarios for running the tests had to be sent to users by email. The results are summarized on Table 6-4.

Table 6-4. Summary of the third usability tests.

Task 1	In this task the user should insert history information for a given general record. This task was designed to be forwarded by email to users.			
	Planned Time	**Executed Time**	**Effectiveness**	**Efficiency**
User 1	1:48 s	1:46 s / 0:40s	✗	✗
User 2	1:48 s	1:02s	✓	✓
Execution Result	User 1 found difficult to find the menu option to record history information. The user ended up going to the request editing screen and used the “observation” field, as she did not know that the option to register the history existed in the system. However, after the evaluator's interference, explaining what was expected of the task, the user was able to easily find the menu option and was also able to successfully complete the activity. User 2 understood well what needed to be done and had no difficulty finding the menu for the history record. Managed to enter the information properly and within the expected time.			
Task 2	In this task, the user should print two functional cards (in batch) in the same file (pdf). the purpose of this task is to carry out the usability test in the print module, allowing the user to go through all the steps necessary for a print. This task was designed to be forwarded by email to users.			
	Planned Time	**Executed Time**	**Effectiveness**	**Efficiency**
User 1	4:50 s	4:15 s	✗	✓
User 2	4:50 s	4:43 s	✓	✓
Execution Result	User 1 was able to print the functional card, but during the process the user did not have the correct understanding of how to print in batch. So, the user managed to reach the print screen but only for one user. She was unable to batch print. In this case, the user herself, at the end of the task, identified her error and reported that she had no difficulty in the interface, she just wasn't aware of what was requested. User 2 was able to print the requested functional identification card, making the requests in advance, filling in the required fields and then being launched into the print module. As the objective of the task was to be able to print the requested cards in batch, the user achieved the objective of the task. This point was very important for us to validate if the menu options were clear enough so that the user could make the proper navigation.			
Task 3	In this task the user should insert a misplacement information in the history module. This task was designed to be forwarded by email to users.			
	Planned Time	**Executed Time**	**Effectiveness**	**Efficiency**
User 1	1:48 s	0:48s / 0:40 s	✗	✗
User 2	1:48 s	1:10 s	✓	✓

Execution Result	Here, User 1 was also confused, thinking that the history information had to be included using the observation field. After the intervention of the evaluator, User 1 was able to understand the process and was able to complete the activity within the expected period. User 2 was able to find the information quickly. It took a little longer just to include the information in the descriptive field, but it managed to successfully activate the task objective.			
Task 4	In this task the user should find a specific information and delete it from the history module. This task was designed to be forwarded by email to users.			
	Planned Time	**Executed Time**	**Effectiveness**	**Efficiency**
User 1	01:10 s	00:43 s	✓	✓
User 2	01:10 s	00:27 s	✓	✓
Execution Result	Here, User1 was able to find the option for the history of a given RG and was able to identify the information to be deleted. The record then was successfully deleted. User 2 also correctly identified the path to the history of the given RG informed, pressed the delete button correctly and the record was successfully deleted and within the expected time.			

After performing the tests, users were asked about the impression they had in using the specific modules. They were asked if the modules were easy or medium to use or if they found the interaction with the new interface complicated. According to the reports of both users, the system is easy to navigate, but there is an initial difficulty because they are already very used to the current system and end up trying to repeat the same processes that are carried out today. As there was a change in the process, there is an initial difficulty, but nothing that prevents the use of the system.

In general, users easily adapted to the interface and the new way of working with the upper menus. Users reported that they found it easy to learn how to use the routines and also liked this new way of accessing work routines.

In the history module a small text editor was made available, where the user can enter texts in bold, italic, and make text markings. The solution allows the inclusion of histories manually, as well as the visualization of log information that are automatically inserted by the existing routines. Users were very satisfied with the result.

Some suggestions were requested by the users such as: the inclusion of the timer (loading information) to make it clear that the system is running, performing some action, thus preventing the user from clicking several times on a button or link to perform an action, the inclusion of a search by identification card number, and the possibility of including attachments in the records.

To measure user's satisfaction in relation to each module, a Likert scale was used again (totally unsatisfied, unsatisfied, neutral, satisfied, totally satisfied). In the history module, users were totally satisfied, as currently the historical files are kept in "dead file" at the workplace itself. Even with the information in physical files, users showed concern when there was a need to recover the information, as they are currently not indexed. So, there would be a big difficulty if they had to recover any document in the format that exists today. Therefore, allowing the digitization of documents and the inclusion of this information, ensuring the security and availability of information, is a great step forward for the Institution.

6.3.1.4 Fourth Usability Tests

The fourth test performed was aimed at testing the usability of the other scenarios available in the functional identifications card module. The idea is to cover in the tests the main routines used in this module, such as: retention, return, reprint, copy, devolution and reactivation. The results are summarized on Table 6-5.

Table 6-5. Summary of the fourth usability tests.

Task 1	In this scenario, the user should register in the system the retention of a specific functional identification card. The data for carrying out the registry research were sent to the user by e-mail.			
	Planned Time	**Executed Time**	**Effectiveness**	**Efficiency**
User 1	05:51s	05:44	✓	✓
User 2	05:51s	00:54 / 04:23	✓	✓
Execution Result	User 1 could easily find the option to execute the retentions of a specific functional identification card on the initial screen. However, the user felt difficulty in finding the option to attach files and therefore only reported orally the actions that would be performed. The user also initially felt difficulty in finding the error that was being displayed on the screen, due to the scroll bar, as to proceed with the task it was necessary to select the Acceptance Term. The user was able to finish the task within the estimated time. User 2 was a little confused at first to perform the activity. As in the current system is not necessary to register the retention of a specific functional identification card, as a differentiated process, the user ended up accessing the registration screen of the functional identification history, as how the process is currently carried out. Therefore, the evaluator had to interrupt the test after (00:54 s) and then clarify that new scenarios were included in the new system. This would be precisely to facilitate the process and later assist in the identification of records and documents in the history. The user was able to successfully complete the routine. At the end of the process, User 2 also identified the need for a retention receipt to be delivered to the owner of the document in question.			

Task 2	In this scenario, the user should register in the system the return of a specific functional identification card (in cases of dismissal for example). The data for carrying out the registry research were sent to the user by e-mail.			
	Planned Time	**Executed Time**	**Effectiveness**	**Efficiency**
User 1	02:20	00:44	✓	✓
User 2	02:20	04:09	✓	×
Execution Result	User 1 easily found the option to return a specific functional identification card. The routine was carried out successfully and within the expected time. User 1 also demonstrated during the test that she could not necessarily print the resignation receipt but just sign the letter that she received, requesting the return of the functional card. The User 1 could scan and attach it to the system. When performing this test, user 2 was again in doubt about what action she should take. However, in this case, we conclude that perhaps the document sent by e-mail, requesting the execution of the activity for this scenario, may have raised doubts in carrying out the test. The difference in nomenclature in the terms used, probably ended up generating this doubt in user 2. After clarification of this issue by the evaluator, user 2 was able to complete the task.			
Task 3	In this scenario, the user should register the request for reprinting a specific functional identification card. The data for carrying out the registry research were sent to the user by e-mail.			
	Planned Time	**Executed Time**	**Effectiveness**	**Efficiency**
User 1	01:41	00:49	×	✓
User 2	01:41	01:13	×	✓
Execution Result	In this test, User 1 ended up performing a task improperly. The idea would be for the user to register a request for reprinting, but the user ended up accessing the duplicate routine in the menu. Despite this, the execution of the copy request was carried out successfully. Task execution times were recorded so that we could analyze the results. Then, the reprint test was performed. User 1 explained, at the end of the test, that in most cases the duplicate routine is used and there is no obligation to inform the police report number as shown. The term "reprint" is rarely used and that is why it ended up leading the user to make this mistake. In this test, User 2 also ended up performing a task improperly. The idea would be for the user to register a request for reprinting, but the user ended up accessing the duplicate menu. The same explanation given by User 1 was also informed by User 2.			
Task 4	In this scenario, the user should register the request for a copy of a specific functional identification card. The data for carrying out the registry research were sent to the user by e-mail.			
	Planned Time	**Executed Time**	**Effectiveness**	**Efficiency**
User 1	03:30	02:40	×	✓
User 2	03:30	01:47	×	✓
Execution Result	As in the previous activity, Users 1 and 2 ended up performing the steps to execute the request for a duplicate, in this test, the user was therefore asked to proceed with the test of a reprint. Thus, it would be possible to take note of the execution times and also validate the proposed scenarios. Task execution times were recorded so that we could analyze the results.			

	Both users were able to perform the task successfully. Due to this confusion of nomenclature, the evaluator had to intervene and explain the situation before the evaluation itself.			
Task 5	In this scenario, the user should register a devolution of a specific functional identification card. The data for carrying out the registry research were sent to the user by e-mail.			
	Planned Time	**Executed Time**	**Effectiveness**	**Efficiency**
User 1	01:15	00:48	✓	✓
User 2	01:15	00:36	✓	✓
Execution Result	User 1 easily find the menu option to execute a devolution of a specific functional identification card to an employee. The activity was successfully completed without major difficulties and within the expected time. In this scenario, User 2 was able to easily identify the activity that he should perform. Therefore, it was possible to complete the activity effectively and within the expected time.			
Task 6	In this scenario, the user should register a reactivation of a specific functional identification card. The data for carrying out the registry research were sent to the user by e-mail.			
	Planned Time	**Executed Time**	**Effectiveness**	**Efficiency**
User 1	02:50	00:45	✓	✓
User 2	02:50	00:45	✓	✓
Execution Result	User 1 easily find the menu option to execute a reactivation of a specific functional identification card. The activity was successfully completed without major difficulties and within the expected time. In this scenario, User 2 was able to perform the proposed activity effectively and within the expected time. But again, User 2 warned about the nomenclature, as currently this action is not performed in the current system and may, at first, cause some doubt in the user.			

To measure user's satisfaction in relation to each module, a Likert scale was used again (totally unsatisfied, unsatisfied, neutral, satisfied, totally satisfied). In this module, where various scenarios were tested, users rated as satisfied with the evaluated scenarios. We also identified a problem with the nomenclature of the third and fourth scenarios (duplicate, reimpression) which also, through the tests performed, we were able to re-evaluate and readjust the process, not keeping the information from the police reports as mandatory.

6.3.2 Lessons Learned

After the conclusion of each sprint, retrospective meetings were held, and various feedbacks were captured and recorded as lessons learned. Below we described them:

- The need to subdivide the activities that were being placed in the sprints was identified. The fact that we kept larger activities is that they ended up not being completed and the execution of activities ended up not being reflected in the burndown graph.
- The deadlines for completing the tasks and work items were underestimated. The difficulties with communication with the customer, support and staff, encountered by each one, working in home office during the pandemic period, were not well considered. Over time, team members were able to adapt and improve the estimates.
- It was identified that it would not be possible to carry out usability tests as often as the model was proposing. There were two main difficulties: having a deliverable module to carry out the tests and the availability of the users to carry out the tests. Because of this was necessary to readjust the schedules so that we could carry out usability tests.
- The need to improve the description of user stories and validate the project documentation so that new developers joining the team, with the project already underway, can have a better understanding of the activities.
- It was also identified the need to verify the changes suggested after the usability test carried out with the users, for subsequent inclusion in a new sprint. All suggestions and notes after the usability test were passed on and explained to the development team, but it was identified the need to create a checklist to validate what was raised and what was actually done.
- Points of attention were also identified when conducting remote usability tests, as in some situations we had connection problems which made it a little difficult for the agility and progress of the tests to be carried out. We recommend that access and connections must be tested before testing takes place to avoid delays in execution. We also recommend

using cameras for better communication and test execution. The use of the recording tool also helped us to review the results obtained.

- It was also verified that in some usability tests, users had difficulty running the test due to the difference in nomenclature used in the new process. Therefore, we registered as a lesson learned the review of the documents used in the processes, as well as the assembly of test scripts, so that the new nomenclatures do not cause strangeness to users.

With the end of the development phase, this step is concluded. At this point we can summarize the artifact (value proposition canvas) and perform a checklist of the pain points. In this way, it will be possible to validate whether all the pains initially identified in the project were remedied during the development of the application, as described on Table 6-6.

Table 6-6. Summary of identified pain points and how they were remedied.

Pain Points	Requirements *Backlog*/*Painkillers*	Package/ Sprint	Observation	Accomplished
1) Lack of security with the database (no backup)	Database backup routine inclusion and trace log inclusion	All Sprints	The system was developed using a specific API from SespIntanet that allows the inclusion of logs of all system routines. So, since the first sprint we can say that this requirement is being met.	✓
2) Many controls performed manually	Automation of processes and reduction of control by employees	Sprint 1 and Sprint 5 (Maintain Seal Module) Maintain Functional Identification Card	The Maintain Seal module was the first module developed and already meets this requirement. In the current process the police chief has to sign all functional identity cards manually. This process is time-consuming and requires great control by employees. In other functionalities, as in all portfolio request scenarios, integrations were developed with other systems (e-protocolo,	✓

			BOU, Meta4, SIV) that enabled the automation of various processes.	
3) Cost of printing functional identification cards 4) Manually performed functional identification cards finishing process	Hiring a company to perform the printing (outsourcing)	Sprints 7, 8, 15, 16	The system was developed to work with the hiring of an outsourced service, but the initial version that is going to be deployed will still be printed by the IIPR itself. This decision was taken, as it will be necessary to wait for the alteration of the State decree that establishes the standards for printing the identification cards.	Partially accomplished
5) Low control against counterfeits 6) Low durability of functional ID cards	Use of the Ministry of Justice ordinance N 320	Sprints 7, 8, 15, 16	The requirements for printing the card according to the rules of the ministerial ordinance have already been implemented. Even not being used at this time, the system was already prepared to meet this requirement.	✓

According to the summary shown in Table 6-6, we can identify that practically all pains identified in the value proposition canvas were remedied. Only the contracting of a third-party company to carry out the printing of the cards was pending, as this requirement is totally dependent on the modification of State Decree 8135 of 2017, which establish the rules for the printing of functional identity cards in Paraná.

With the remediation of these pains, the vast majority of problems identified by users will already be solved in this first version that will be implemented. In addition, several benefits of this new application were also identified, such as the possibility of scaling this system, so that it can be used by other departments of the SESP (Military Police, DEPEN, Scientific Police), greater data reliability, the possibility of tracking information and also reduce the cost of printing functional ID cards.

Another gain identified but not yet implemented is the possibility of biometric validation when withdrawing the functional identification card. This requirement has not

yet been implemented only due to the logistical issue, as this would force employees from the interior to also have to come face-to-face to pick up their identification cards in the Capital.

With the completion of this stage, we are moving towards preparing the necessary environment to deploy the Functional Identifications Card Module and also evaluate the approach. For the assessment of the approach two evaluations were planned: one from end users' point of view and other from project participants' point of view.

6.4 First Evaluation: end users' point of view

As already described our intention in this first evaluation was, primarily, to analyze the answers related to the user's experiences taken from the use of the actual system available. For this we sent the meCUE questionnaire for 2 users of the actual system. We compiled the results and generated the graphics below. As already described, this questionnaire consists of five separately validated modules which refer to instrumental and non-instrumental product perception (usefulness and usability), user emotions (visual aesthetic, status and commitment), consequences of usage (positive and negative emotions), attractiveness (intention to use and product loyalty) and an overall evaluation. The graphs, presented in Figure 6-1, represent the consolidation of the results obtained after the system users completed the meCUE questionnaire to capture the actual system users' experiences.

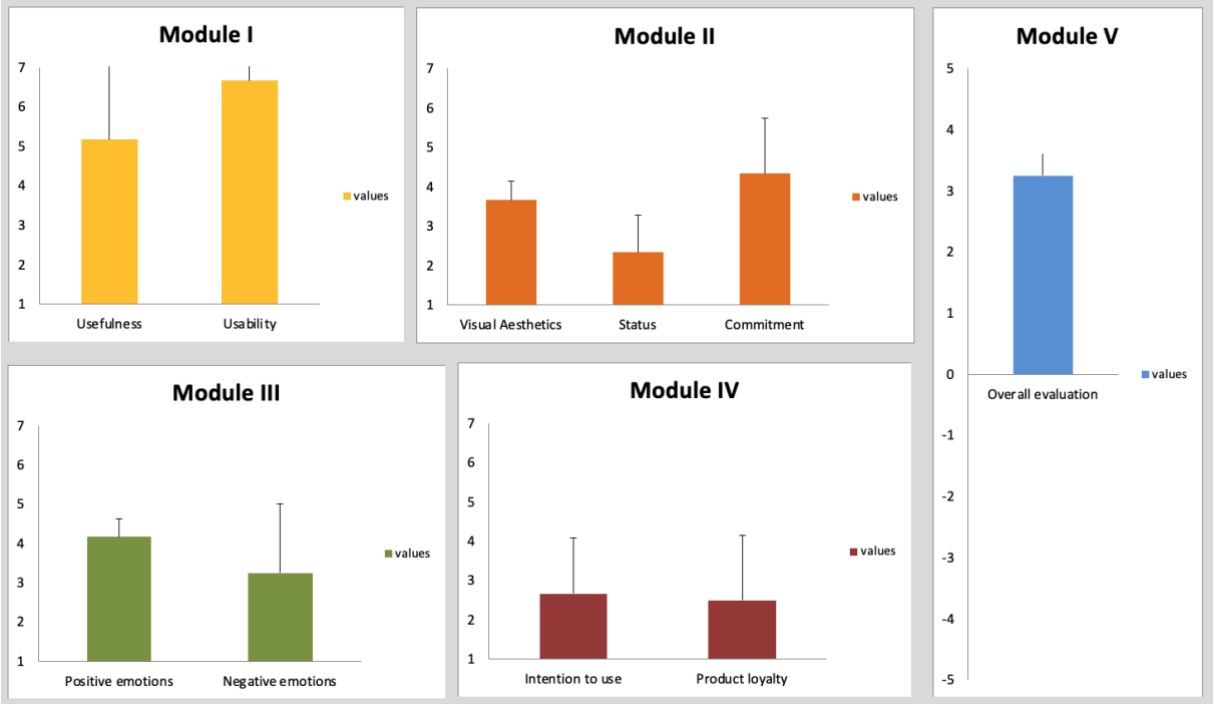

Figure 6-1. Results from the current system users' experiences.

The graphs aim to demonstrate the result of mean values and standard deviations calculated from the meCUE questionnaire.

After completing this phase, the team started to develop the new solution using the new proposed approach. At the end of the development, we also applied the meCUE questionnaire for the same users that already have answered the questionnaire. But at this time the focus was to capture the user's experiences related to the new solution developed. Figure 6-2 demonstrate the results obtained from our findings.

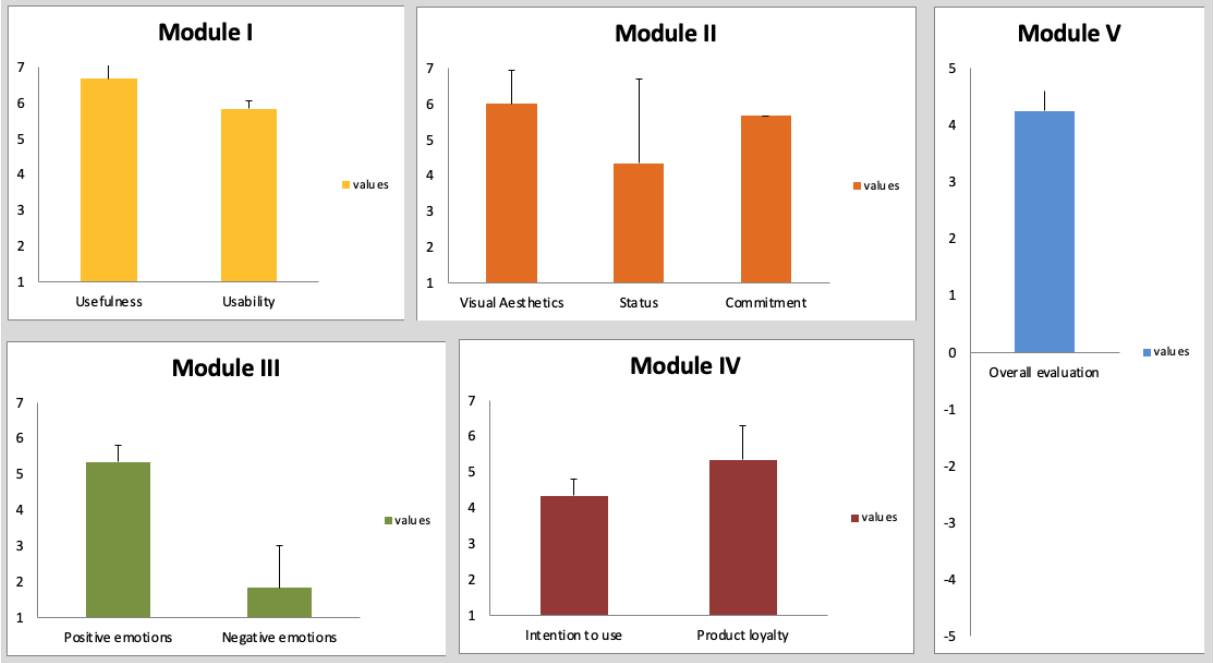

Figure 6-2. Results from the new solution user's experiences.

When this research was being thought out and developed, the idea was that we could have a larger volume of users to be able to validate the application from the user's point of view. However, we had several difficulties in finding a project with the necessary characteristics to apply the study, within a viable time to collect the results. Thus, the calculation of the mean and standard deviation ends up becoming unfeasible for this context, as we only had two users to evaluate. Therefore, the above results end up being merely expository, as we will then present a qualitative analysis of the results. However, it is possible to see, comparing the results of the presented modules, that in practically all modules the results with the new solution were better. Only the usability item, represented by Module I, had a lower rating. But this will be justified in the analysis below where a Likert scale was used. The statement "strongly disagree" is given the value of "1", the statement "disagree" is given the value of "2", the statement "somewhat disagree" is given the value "3", the statement "neither agree nor disagree" is given the value "4", the statement "somewhat agree" is given the value "5", the statement "agree" is given the value "6", the statement "strongly agree" is given the value "7".

6.4.1 Module I – Perceptions of instrumental qualities

In the first module, the results are based on two instrumental qualities: usability (U) and functionality (F). The analyzed items and their respective results, obtained from the responses of the two users, are listed above, as shown in Table 6-7.

Table 6-7. Summary of the results obtained from Module I.

Id. Code	Item	User 1 (current system)	User 1 (new solution)	User 2 (current system)	User 2 (new solution)
U1	The product is easy to use.	7	6	6	6
U2	It is quickly apparent how to use the product.	7	6	6	5
U3	The operating procedures of the product are simple to understand.	7	6	7	6
F1	The functions of the product are exactly right for my goals.	3	7	7	6
F2	I consider the product extremely useful.	6	7	7	7
F3	With the help of this product, I will achieve my goals.	2	7	6	6

Analyzing the obtained results, we can verify that the items related to the usability of the new solution, were not better evaluated by the users, as we expected. During the usability tests it was noticed the difficulty of users in performing some activities since the first test. This is because there was a change in the process, with the automation of some routines, leaving the user in doubt about the actions that should be taken. Users had been working with the current system for a few years and used to carry out the tasks always in the same way. It was found that every change generates an impact and an initial resistance. However, with the understanding of the new process and the clarification of initial doubts, the ease of use the system and the improvements that were built into it became clear.

Regarding the items related to functionality, there was a clear improvement in user 1's ratings, considering the new solution extremely useful, aimed at meeting the objectives needed to fulfill the activities. On the other hand, user 2's assessment did not reach such expressive amplitude, remaining practically the same as the previous

assessment. This leads us to believe that both systems have functionalities that are extremely important and useful in the daily activities performed by users, facilitating the fulfillment of the demands imposed on the development of their activities.

6.4.2 Module II – Perceptions of non-instrumental qualities

In the second module, the results are based on three non-instrumental qualities: visual aesthetics (A), status (S) and commitment (C). The analyzed items and their respective results, obtained from the responses of the two users, are listed above, as shown in Table 6-8.

Table 6-8. Summary of the results obtained from Module II.

Id. Code	Item	User 1 (current system)	User 1 (new solution)	User 2 (current system)	User 2 (new solution)
A1	The product is creatively designed.	5	7	5	6
A2	The design looks attractive.	3	6	3	5
A3	The product is stylish.	2	7	4	5
S1	The product would enhance my standing among peers.	1	2	3	6
S2	By using the product, I would be perceived differently.	2	4	2	6
S3	I would not mind if my friends envied me for this product.	2	2	4	6
C1	I could not live without this product.	4	5	5	5
C2	The product is like a friend to me.	5	6	6	6
C3	If I ever lost the product, I would be devastated.	4	6	5	6

According to the results obtained, the items related to visual aesthetics and status were better evaluated in the new solution, as expected. There was a great effort of the UX Designer to make the interface more visually pleasing and attractive. The results just confirm the good work done by the UX Designer and development team to

make the new system more stylish. It also makes users feel that the solution has potential, placing them in a different position among their peers.

Assessing the results obtained in relation to the commitment to the product, it can be seen that user 1 also evaluated the new solution with better results. This also demonstrates the good work carried out through the approach proposed in this study, making the user feel involved with the new solution. The results obtained from user 2, in spite of having remained practically constant when compared to the current solution, also represent a good result achieved if evaluated in isolation.

In general, 88% of the evaluated items related to visual aesthetics, status and commitment were better evaluated. In only two of the nine items evaluated, one of the respondents remained with the same score as in the previous evaluation.

6.4.3 Module III – Perceptions of user emotions

In the third module, the results are based on two strands linked to the emotional perceptions of users: positive emotions (PA- positive activation, PD- positive deactivation) and negative emotions (NA- negative activation, ND – negative deactivation). The analyzed items and their respective results, obtained from the responses of the two users, are listed below, as shown in Table 6-9.

Table 6-9. Summary of the results obtained from Module III.

Id. Code	Item	User 1 (current system)	User 1 (new solution)	User 2 (current system)	User 2 (new solution)
PA1	The product exhilarates me.	4	4	5	5
PA2	The product makes me feel euphoric.	2	5	4	6
PA3	When using this product, I feel cheerful.	4	6	5	5
PD1	The product relaxes me.	4	6	4	5
PD2	The product makes me feel happy.	5	7	5	5
PD3	The product calms me.	4	6	4	4
NA1	The product annoys me.	2	1	5	3
NA2	The product frustrates me.	3	1	4	2
NA3	The product angers me.	2	1	5	1

ND1	The product makes me tired.	2	1	5	4
ND2	When using this product, I feel exhausted.	1	1	4	2
ND3	The product makes me feel passive.	2	1	4	4

According to the obtained results, it was possible to observe that most of the analyzed items related to positive emotions had better results with the new developed solution. With user 1 the results were more evident as the difference in results had a large margin. With user 2, the results remained practically constant, with 2 of the 6 items being better evaluated. However, in none of the evaluated items a worse performance was observed. This also leads us to believe that overall, the new product produced more positive emotions, making the user feel happier, calmer and even emotional.

Regarding the perception of negative emotions, the evaluations carried out by both user 1 and user 2 had significant drops. This demonstrated that the new system is less likely to irritate, annoy, frustrate or exhaust the user.

6.4.4 Module IV – Consequences of use

In the fourth module, the results are based on two items related to the consequences of use: intention to use (IN) and product loyalty (L). The analyzed items and their respective results, obtained from the responses of the two users, are listed below, as shown in Table 6-10.

Table 6-10. Summary of the results obtained from Module IV.

Id. Code	Item	User 1 (current system)	User 1 (new solution)	User 2 (current system)	User 2 (new solution)
IN1	If I could, I would use the product daily.	2	4	4	6
IN2	I can hardly wait to use the product again.	2	4	3	4
IN3	When using the product, I lose track of time.	1	4	4	4
L1	I would not swap this product for any other.	1	6	3	4

L2	In comparison to this product, no others come close.	1	6	4	4
L3	I would get exactly this product for myself (again) at any time.	1	6	4	6

Regarding the intention to use the new developed product, it was possible to observe that the three items evaluated obtained better results by both users. But we cannot affirm that this demonstrates the interest of users in using the new software developed. Most items, related to the new solution, were evaluated as neutral items, that is, the user neither agreed nor disagreed with the item in question that was being evaluated.

Regarding the loyalty item, the ratings of both users were very positive. This indicates that despite not having shown greater intentions of use, when put into testing, users realized the great differences and benefits that the new solution could bring and become loyal to the solution.

6.4.5 Module V – Overall evaluation

In this module the result will be evaluated numerically. Users should rate the system by answering the following question: How do you experience the product as a whole? The answer should be answered using a value between -5 and +5, respecting an interval scale of 0.5. The results are shown in Table 6-11.

Table 6-11. Summary of the results obtained from Module V.

Question	User 1 (current system)	User 1 (new solution)	User 2 (current system)	User 2 (new solution)
How do you experience the product as a whole?	3,5	4,5	3	4

In general, both users evaluated the new solution with better results in relation to the experience they obtained with the use of the product as a whole, when compared to the current version of the system. This demonstrates that the software produced met the expectations of users in general and produced better experiences when compared to the software currently available.

The main goal of our evaluation was to explore and find evidence to answer the following question: **How does the use of the proposed approach affect the outcome of the project development in relation to the user experience perceptions?**

According to our findings we can conclude that the use of the current approach could bring several benefits to users. This was evident after analyzing the results obtained in each module of the meCUE questionnaire. Although we did not maintain the same results in the usability criterion, in general the system was also well evaluated when analyzed in isolation. The evaluation of the software as a whole also gave us assurance that all the effort made while using the new approach produced excellent results.

6.5 Second Evaluation: work team's point of view

To execute the second evaluation, the TAM (Technology Acceptance Model) questionnaire was also sent to be answered by the team involved in the use of the new proposed approach. As already described, this model proposes to evaluate technologies according two perspectives: usefulness and ease of use. Before sending the questionnaire to be answered it was necessary to translate the questions from English to Portuguese to facilitate the team understanding, since not all members were fluent in English. We had 4 responses from different roles. Table 6-12 and Table 6-13 summarize the answers captured.

Table 6-12. Answers of Perceived Usefulness.

Statements	Degree of agreement (System Analyst)	Degree of agreement (Developer)	Degree of agreement (Developer)	Degree of agreement (UX Designer)
1. My job would be difficult to perform without the new approach (UXIAD).	Agree	Agree	Disagree	Disagree
2. Using the new approach (UXIAD) gives me greater control over my work.	Agree	Strongly Agree	Agree	Somewhat Agree
3. Using the new approach (UXIAD) improves my job performance.	Agree	Strongly Agree	Somewhat Agree	Neither Agree nor Disagree
4. The new approach (UXIAD) addresses my job-related needs.	Agree	Strongly Agree	Somewhat Disagree	Somewhat Disagree

5. Using the new approach (UXIAD) saves me time.	Agree	Agree	Neither Agree nor Disagree	Somewhat Agree
6. The new approach (UXIAD) enables me to accomplish tasks more quickly.	Agree	Agree	Somewhat Disagree	Neither Agree nor Disagree
7. The new approach (UXIAD) supports critical aspects of my job.	Agree	Agree	Agree	Neither Agree nor Disagree
8. Using the new approach (UXIAD) allows me to accomplish more work than would otherwise be possible.	Agree	Neither agree nor disagree	Neither Agree nor Disagree	Neither Agree nor Disagree
9. Using the new approach (UXIAD) reduces the time I spend on unproductive activities.	Strongly Agree	Neither agree nor disagree	Somewhat Agree	Neither Agree nor Disagree
10. Using the new approach (UXIAD) enhances my effectiveness on the job.	Agree	Strongly Agree	Agree	Neither Agree nor Disagree
11. Using the new approach (UXIAD) improves the quality of the work I do.	Agree	Agree	Strongly Agree	Neither Agree nor Disagree
12. Using the new approach (UXIAD) increases my productivity.	Agree	Strongly Agree	Somewhat Disagree	Neither Agree nor Disagree
13. Using the new approach (UXIAD) makes it easier to do my job.	Agree	Strongly Agree	Neither Agree nor Disagree	Somewhat Agree
14. Overall, I find the new approach (UXIAD) useful in my job.	Strongly Agree	Strongly Agree	Somewhat Agree	Somewhat Agree

Table 6-13. Answers of Perceived Ease of Use.

Statements	Degree of agreement (System Analyst)	Degree of agreement (Developer)	Degree of agreement (Developer)	Degree of agreement (UX Designer)
1. I often become confused when I use the new approach (UXIAD).	Disagree	Strongly Disagree	Disagree	Neither Agree nor Disagree

2. I make errors frequently when using the new approach (UXIAD).	Disagree	Strongly Disagree	Neither Agree nor Disagree	Somewhat Agree
3. Interacting with the new approach (UXIAD) is often frustrating.	Disagree	Strongly Disagree	Strongly Disagree	Neither Agree nor Disagree
4. I need to consult the user manual often when using the new approach (UXIAD).	Disagree	Strongly Disagree	Neither Agree nor Disagree	Disagree
5. Interacting with the new approach (UXIAD) requires a lot of my mental effort.	Disagree	Strongly Disagree	Disagree	Disagree
6. The new approach (UXIAD) is rigid and inflexible to interact with.	Disagree	Strongly Disagree	Disagree	Disagree
7. I find it cumbersome, to use the new approach (UXIAD).	Disagree	Strongly Disagree	Disagree	Neither Agree nor Disagree
8. My interaction with the new approach (UXIAD) is easy for me to understand.	Agree	Strongly Agree	Agree	Somewhat Agree
9. It is easy for me to remember how to perform tasks using the new approach (UXIAD).	Agree	Strongly Agree	Strongly Agree	Neither Agree nor Disagree
10. The new approach (UXIAD) provides helpful guidance in performing tasks.	Agree	Strongly Agree	Agree	Neither Agree nor Disagree
11. Overall, I find the new approach (UXIAD) easy to use.	Agree	Strongly Agree	Agree	Neither Agree nor Disagree

6.6 Results from TAM Questionnaire

As we had only 4 responses a quantitative analysis is not indicated. Due to this fact our intention is to discuss and explore the collected answers from a qualitative point of view. It is important to emphasize here that the questionnaire was sent to all development team participants who have different roles. Therefore, these different points of view will be considered during this analysis.

6.6.1 Results from the first respondent

Results of Perceived Usefulness: Analyzing the answers of the first respondent who acted as a system analyst, we can see that the proposed new approach brought several benefits in terms of usefulness. According to his answers, the new approach provided greater control and ease in carrying out their activities, saving time allowing them to perform tasks faster and reducing the time spent on unproductive activities. In general, the respondent assesses that the approach facilitates his work and believes that the application in his work is useful.

Results of Perceived Ease of Use: Regarding to ease of use, the first respondent agrees that the approach is easy to understand, easy to use and iterate on and provides helpful guidance in performing tasks. In general, it is clear that the first respondent had no major problems in adapting to the new approach as disagreed with the statement that the approach would be rigid or inflexible to interact with or that it would require great mental effort to adapt. The respondent also disagrees with the fact that interaction with the new approach is frustrating or that he makes frequent mistakes when using the new approach.

After answering the questions, the respondent was asked to comment on your experience with the used approach, and here we highlight some comments:

1) “*Working in sprint allows us to deliver a product to the final customer, it's good for the team that sees the project in progress and good for the customer who knows their project is being met.*”
2) “*Planning tasks with agreed deadlines is perhaps the most positive point in my opinion.*”
3) “*The usability test done with the customer after each delivery is positive as we do not need to wait for the end of the delivery as a whole to get the customer's opinion, adjustments are then made after each test. If only a single test were done at the end of the project, critical problems could be found to be corrected by business rules that would delay completion*.”

These positive characteristics pointed out by the systems analyst were evident during the development process, as it provided an increase of productivity, saving time and allowing some activities to be carried out more quickly.

6.6.2 Results from the second respondent

Results of Perceived Usefulness: Analyzing the answers of the second respondent who acted as a developer we can see that the proposed new approach also brought several benefits in terms of usefulness. According to his answers, the new approach provided greater control and ease in carrying out his activities, saving time allowing them to perform tasks faster and reducing the time spent on unproductive activities. In general, this respondent emphasized even more the gains obtained with the use of the new approach compared to the first respondent and also believes that its application is useful in his work.

Results of Perceived Ease of Use: Regarding to ease of use, the second respondent also agrees that the approach is easy to understand, easy to use and iterate on and provides helpful guidance in performing tasks. In the same way as the first respondent, the second respondent had no major problems in adapting to the new approach. Even having worked with a different role than the first respondent, analyzing the answers it is possible to observe that both had almost the same perceptions. He also disagreed with the statement that the approach would be rigid or inflexible to interact with or that it would require great mental effort to adapt. The respondent also disagrees with the fact that interaction with the new approach is frustrating or that he makes frequent mistakes when using the new approach. Here some comments on his experience with the proposed approach:

1) "*The new approach encourages constant dialogue between team members through daily meetings. This is essential for solving problems, clearing doubts and raising new questions.*"
2) "*The new approach separates each team member with their role, allowing them to do their jobs without shifting focus. It also avoids rework due to the constant dialogue between the team and the customer.*"

The second respondent also realized, during the use of the approach, its usefulness, especially in relation to the division of activities and roles. This allows the collaboration between project team participants, enriching discussions and the project as a whole.

6.6.3 Results from the third respondent

Results of Perceived Usefulness: Analyzing the responses of the third respondent who also acted as a developer, but only in three sprints (7,8 and 9), we can see a slightly different look regarding to perceived usefulness. According to his answers, he partially disagrees as to whether the approach has addressed the needs related to his activities, to allow him to perform his activities faster or also to increase his productivity. But on the other hand, he agreed that the new approach gives him greater control over his work and supports critical aspects of his job.

Results of Perceived Ease of Use: Regarding to ease of use, the third respondent, as well as the first and second respondents, also agrees that the approach is easy to understand, easy to use and iterate on, and provides helpful guidance in performing tasks. In the same way as the previous respondents, the third respondent had no major problems in adapting to the new approach and strongly agrees that is easy to remember how to perform tasks using the new approach. He also disagreed with the statement that the approach would be rigid, inflexible or cumbersome to interact with or that it would require great mental effort to adapt. The respondent strongly disagrees with the fact that interaction with the new approach is frustrating but neither agree nor disagree with the fact that when using the new approach commits frequently errors or often need to consult the user manual.

Here some comments on his experience with the proposed approach:

1) "*As a developer who participated in a few sprints, I missed a more detailed description of use cases. A very high-level description of tasks made it difficult to give more accurate estimates of the work involved and a complete understanding of alternative flows."*
2) *"The prototyping of the screens already presented and discussed with the users helped to understand the tasks and avoided rework*."

The answers obtained from the third respondent also reinforce the impressions obtained during the monitoring of the project, where some difficulties were reported by him regarding the understanding of the demands, as detailed descriptions of use cases were not carried out, but the technique of user stories was used. As the company already has a development methodology, which is based on the use of use cases, the developer missed a more detailed description of the features. To minimize these

effects, we had to work more on project communication, further reinforcing the need to clarify obstacles during daily meetings.

On the other hand, the respondent also pointed out some positive aspects of the workshops initially held in the project to create the proposed artifacts. The prototypes built and validated with customers helped a lot in understanding the demands to be developed. Although the evaluations regarding the issue of time and productivity were not so positive from the point of view of this respondent, an important and very relevant aspect for the evaluation of the proposed approach is the final quality of the work performed. The respondent strongly agrees that using the approach improves the quality of the work he has done.

6.6.4 Results from the fourth respondent

Results of Perceived Usefulness: Analyzing the responses of the fourth respondent, who acted as a UX Designer, regarding to the perceived usefulness we can also have a slightly different look. According to his answers, he somewhat agrees that the proposed approach give him greater control over his work, saves time, make easier to do his job and find it useful. But in most of the items evaluated, the respondent neither agrees nor disagrees.

Results of Perceived Ease of Use: According to the answers of the fourth and last respondent, regarding to the perceived ease of use he disagrees with the statement in which says that it was often necessary to use the manual or that it took a lot of mental effort to interact with the new approach. He also disagrees with the fact that the new approach is rigid or inflexible to interact with.

The respondent stated that he partially agrees with the fact that he made frequent mistakes when using the new approach. When we follow the project development, we realize that this role is one of the most impacted on the project activities, mainly in the execution and creation of the main artifacts. Therefore, an initial difficulty in adapting to new activities, tools and artifacts would be natural. And for this reason, we believe that the respondent also partially agreed that their interaction with the approach is easy to understand. Only an initial impact made these difficulties appear. Here some comments on his experience with the proposed approach:

1) "*The approach used the concept of User-Centered Design which allowed the development and creation of new interfaces, leaving the conventional standards.*"
2) "*As a member of the team who participated in the project, I had no problems adapting to the approach.*"
3) "*Difficulty when a person becomes a member of the project without having participated in the initial phases to find information about the documentation of what must be done."*

According to the results obtained from the fourth respondent, who actively participated in the elaboration of the initial artifacts, such as personas, canvas, prototypes and backlog, the new approach was easy to adapt. But again, it was highlighted in his comments about the difficulty of inserting new participants (developers) to the project. As the company currently has a development methodology based on the construction of more detailed use cases, the lack of this information ended up making the transfer of information and communication more frequent.

6.7 Limitations and Threats to Validity

The first limitation regarding the results of this work is related to the number of companies in which we were able to develop the approach. As the development of the approach required some minimum pre-requisites, such as the use of agile methodologies and also the need of a short project so that we could adapt our time limitation to complete the work, these factors ended up limiting it in some way the results. However, to facilitate the use of the approach, not only in this but in other organizations, we have already made available the description of the process itself, as well as the templates for use.

The first threat to the study's validity lies precisely in the fact that we have deadlines to be met in the project, and precisely at the beginning of the workshop's development, it coincided with the beginning of the COVID-19 pandemic. Therefore, there was a need to adapt the team to the new reality, adjusting the work environment to enable remote access, as well as the entire project management had to be re-adapted due to initially difficult communication. To mitigate the possible side effects of this necessary adaptation, from the beginning of the remote work, we established a fixed time for the meetings that took place daily at 9:15 am. We also had to adapt the usability tests, which could not be performed in person due to a State Decree that

prevent the agglomeration of people, and we started to perform them remotely with the customer. For this, we used a corporate tool that made it possible to complete the activities that were pre-established.

Regarding the validity of the construct, we can say that the application of the approach was the way found to validate it. Even though the results were limited to only one organization, templates of the materials used were created, making the study easier to replicate.

Regarding the reliability of the results generated although the study was carried out with only one organization, it was possible to obtain results through academy validated questionnaires (TAM and meCUE) to carry out a qualitative analysis of the results. No statistical analysis was performed, as there was no adequate sample for this type of analysis. The study used the Technology Acceptance Model (TAM), used in several studies in the literature, and even with few participants, we were able to assess the perceived usefulness, perceived ease of use for the four assessments. The meCUE questionnaire enabled a qualitative analysis of the results, but from the point of view of the customers, regarding the experience of using the final product that was developed. However, we consider that our findings are subject to validation or refutation by further studies.

6.8 Considerations about this chapter

In general, the results obtained from the meCUE and TAM questionnaire were positive. Both aspects regarding the perception of usefulness and ease of use were recognized by users, some more intensely, others more discreetly, but none of the users disagreed with these statements. Some points of improvement in the process were detected during the development process, as in the case of the inclusion of new members, where communication had to be improved so that the new member could understand not only the process but also the approved requirements. Prototypes played a very important role in communication internally, with participants, as well as externally with customers.

Another aspect detected is that as the company already had a well-rooted software development methodology, some of the participants were a little reactive to the use of the approach and initially had difficulty in adapting. But after understanding the process, everyone was unanimous and disagreed with the statement that the approach would be rigid or inflexible to interact.

As already described, during the process of developing and using the proposed approach, some points of improvement were identified and we believe that with these adjustments, the future use of the UXIAD approach can facilitated.

CHAPTER 7 - CONCLUSION

In this chapter the work is positioned to expose its relevance, demonstrating the main contributions, limitations and perspective for future work.

7.1 Final Considerations

Returning to our research question and answering it: **How to integrate usability with agile software development focusing on user experience?**

It was expected in this context to create a new approach where practices, roles and artifacts linked to user experience, could help organizations to improve the software development processes and quality of the created products.

After designing the approach and applying it to a real project, we were able to verify that the approach proposed in this study, UXIAD, is an alternative to the already presented proposals (iteration-ahead, within-iteration BOB, dual track, lean UX, design sprint and Lean Inception). Our aim is to provide a way to anticipate the problems and pain points of the users, document them in a mid-level way, to serve as a compass to guide the other activities to be planned in the sprint backlog and sprint planning. In this proposal, we tried to avoid the use of prototyping as the only artifact to document the product vision, since we consider that the clear understanding of demand as well as the critical aspects of some scenarios (which involve users' feelings and pain points) may not be explicitly documented through prototypes as they are considered key aspects to improve the user experience. We are aware that the discovery phase could be executed more quickly, including the prototyping of high-level screens as proposed by the BoB framework, but we cherish in keeping this “minimum documentation” not only thinking about the quick validation of the business, but also about producing more enjoyable experiences. In addition, according to the results of the case studies, maintaining a minimum documentation, even when using agile methodologies, can help the future maintenance of the developed solutions.

We know that in some realities, such as innovation companies or startups, where the need to validate the business quickly takes place, the use of the BoB

framework is welcome because its characteristics are closer to “lean” approaches. But the approach proposed in this study also has a number of advantages, which can also be compared to other approaches as shown in Table 5-1 of Chapter 5. UXIAD prioritizes UX and UI activities and requirements validation, before starting the development, by generating some specific UCD/UX documentation (user journey maps, prototypes). UXIAD also provides a reduction in the workload of developers by redistributing activities into different roles and works with the idea of creating an MVP in the initial sprints. The proposal is based on design thinking principles (human centered design, evolutionary, context-oriented, visual, multidisciplinary and holistic) i.e. the development and design team does not focus on building an Up-Front Design, but rather on the idea of a minimum that can be improved. The only requirement that the proposed approach is not focused on, is the issue of technical debt support. Within the proposed approach, if a technical debt is detected, it should be treated like the other requirements, entering a backlog and prioritized according to the other requirements. The focus of the approach is to carry out usability tests and after the tests carry out a review of the identified items that should be addressed in the next sprint.

Another advantage of this approach, when compared to others already applied in the market, such as Design Sprint, is the cost involved to keep a multidisciplinary team allocated full time during a whole week. For this reason, we decided in this approach to leave this multidisciplinary composition and the tasks involved less rigid in terms of time of involvement, not setting a fixed time.b

As the results showed, the proposed approach improves the communication and commitment towards product owners, UX designers and the development team. As already described our intention is not to have a faster approach if compared to the previously proposed approaches, but to integrate usability with agile development focusing on better user experiences.

7.2 Study Relevance

With agile methods becoming mainstream even for large-scale organizations in the software industry, software is being delivered on time and in budget, and customer demands are being met increasingly. Nevertheless, agile methods are focused on the question of how useful a product can be developed, focusing on users' needs as a

driver of product requirements. In other words, they do not necessarily develop software that is considered usable. Usability is not a central topic in software engineering, and it is considered one non-functional requirement and quality attribute but has become crucial for a competitive market.

In this way, the academic relevance of the study lies in the evidence that we have demonstrated the variety of existing strategies that have been proposed, over the past decades, to incorporate usability issues into agile software development. In order to address this issue, some studies have proposed integrating the user-centered design (UCD) approach with agile development as a form of solution. Other studies were based on four different criteria: process integration, practice integration, team integration and technology integration. More recently a new criterion was included: the artifact integration. In this same line some recent studies presented proposals to integrate usability to the agile development using agile artifacts. Usually, the artifacts used by the agile development team are focused on maximizing the transparency of information, supporting decisions during the development process, as well as facilitating communication. None of these artifacts are really focused on understanding the user experience as a whole. The consequence of this is that currently various solutions are being created, no matter what the outcome of the user experience.

7.3 Research contributions

Within the presented context, our contributions with the conclusion of this study are:

- Understanding, in organizational practice, how usability is being integrated into agile software development through case studies and the main difficulties of integrating it focusing on user experience.
- An approach (UXIAD), with its respective description of the process and its steps, that allows the integration of usability in an agile framework, allowing the improvement of the quality of the process and consequently of the final products focusing on the user experience.

7.4 Research limitations

Through some case studies, we have been able to identify how software development companies are integrating usability and user experience into agile

software development. At that time, questions were explored on how user-centered design can assist in this integration process, verifying whter this is done in practice. It also explores the main difficulties involved in this integration. However, it should be clear that the purpose of the case studies was to try to explore as much as possible all possible forms of integration, but we know that the conclusions cannot be fully generalized. Our findings are limited to the contexts where data were collected. Many other scenarios could be explored and could also enrich the research.

7.5 Future Works

Future work from this study could include the analysis of other types of companies, not just those of a private nature, so that the conclusions of the case studies could be better generalized. Furthermore, the evaluation of the results presented in this dissertation had to stick to qualitative analysis due to the number of respondents that limited the performance of a quantitative analysis. So, this just emphasizes the need for: 1) other studies to explore more broadly the results, attracting new projects and new respondents; 2) explore other realities in an empirical way other to raise new results that could confirm our findings; 3) execute the proposed approach with other size of projects and teams.

REFERENCES

(AGILE MANIFESTO, 2001) Agile Manifesto: **Manifesto for Agile Software Development**. Available at: <http://www.agilemanifesto.org/>. Accessed on August 19, 2018.

(AHMAD; REXTIN; KULSOOM, 2017) AHMAD, N.; REXTIN, A.; KULSOOM, U. E. **Perspectives on usability guidelines for smartphone applications: An empirical investigation and systematic literature review**. Inf. Softw. Technol., vol. 94, pp. 130–149, 2017.

(ARMITAGE, 2004) ARMITAGE, J. **Are agile methods good for design?** Interactions, v. 11, n. 1, p. 14-23, 2004.

(BANFIELD; LOMBARDO; WAX, 2015) BANFIELD, R.; LOMBARDO, C. T.; WAX, T. **Design Sprint: A Practical Guidebook for Building Great Digital Products.** O'Reilly, 2015.

(BARKSDALE; MCCRICKARD, 2012) BARKSDALE, J.T.; MCCRICKARD, D.S. **Software product innovation in agile usability teams: an analytical framework of social capital, network governance, and usability knowledge management**. Int. J. Agil. Extrem. Softw. Dev, 2012.

(BECK; ANDRES, 2004) BECK, K.; ANDRES, C. **Extreme Programming eXplained: Embrace Change**, second ed., Addison-Wesley, Boston, MA, USA, 2004.

(BERTHOLDO; KON; GEROSA, 2016) BERTHOLDO, A.P.O.; KON, F.; GEROSA, M.A. **Agile Usability Patterns for User-Centered Design Final Stages**. In: M. Kurosu (Ed.), Human-Computer Interact. Theory, Des. Dev. Pract., Springer International Publishing, Cham, 2016: pp. 433–444.

(BEVAN, 2001) BEVAN, N. **International standards for HCI and usability.** In International Journal of Human-Computer Studies, Vol. 55, No. 4, Oct 2001, pp. 533-552.

(BØDKER, 1999) BØDKER, S. **Scenarios in User-Centred Design - setting the stage for reflection and action**. Proceedings of the 32nd Hawaii International Conference on System Sciences,1999.

(BRHEL et al., 2015) BRHEL, M; METH, H.; MAEDCHE, A.; WERDER, K. **Exploring principles of user-centered agile software development: A literature review**. Inf. Softw. Technol, Vol. 61, 2015, pp. 163–181.

(BROSCHINSKY; BAKER, 2008) BROSCHINSKY, D.; BAKER, L. **Using Persona with XP at LANDesk Software, an Avocent Company**. In Agile Conference, 2008, pp. 543-548.

(BROWN, 2008) BROWN, T. **Design thinking**. Harvard business review, 2008, pp. 84-92.

(BRUUN et al., 2018) BRUUN, A.; LARUSDOTTIR, M. K.; NIELSEN, L.; NIELSEN, P. A.; PERSON, J. S. **The role of ux professionals in agile development: A case study from industry**. In Proceedings of the 10th Nordic Conference on Human-Computer Interaction, NordiCHI ’18, Oslo, Norway, 2018: pp. 352–363.

(BUDWIG; JEONG; KELKAR, 2009) BUDWIG, M.; JEONG, S.; KELKAR, K. **When User Experience Met Agile: A Case Study.** In Proceedings of the 27th International Conference Extended Abstracts on Human Factors in Computing Systems,CHI EA ’09, pages 3075–3084, New York, NY, USA, 2009. ACM.

(CABALLERO; MORENO; SEFFAH, 2014) CABALLERO, L.; MORENO, A. M.; SEFFAH, A. **Persona as a Tool to Involving Human in Agile Methods: Contributions from HCI and Marketing.** In Human-Centered Software Engineering, Springer, Berlin / Heidelberg, 2014, pp. 283-290.

(CAGAN, 2012) CAGAN, M. **Dual-Track Scrum.** Available at: <http://www.svproduct.com/dual-track-scrum/>. Accessed on 23, September 2018.

(CAROLI, 2018) CAROLI, P. **Lean Inception: How to Align People and Build the Right Product.** Caroli, 2018, 978-85-94377-01-0.

(CHAMBERLAIN; SHARP; MAIDEN, 2006) CHAMBERLAIN, S.; SHARP, H.; MAIDEN, N. **Towards a framework for integrating agile development and user-centred design.** In: Abrahamsson, P., Marchesi, M., and Succi, G.(eds.) Extreme Programming and Agile Processes in Software Engineering, Springer Berlin, 2006, pp. 143–153.

(CHO, 2009) CHO, L. **Adopting an Agile Culture A User Experience Team’s Journey**. Agile Conference, 2009, pp. 416–421.

(CHOMA; ZAINA; BERALDO, 2016) CHOMA, J.; ZAINA, L. A.; BERALDO, D. **Userx story: Incorporating ux aspects into user stories elaboration.** In: SPRINGER. International Conference on Human-Computer Interaction, 2016. p. 131–140.

(CLELAND-HUANG, 2013) CLELAND-HUANG, J., **Meet Elaine: a persona-driven approach to exploring architecturally significant requirements**. IEEE Software, vol 30, no.04, pp. 18-21, 2013. doi: 10.1109/MS.2013.80

(COCKBURN, 2004) COCKBURN, A. **Crystal Clear: A Human-Powered Methodology for Small Teams**, Addison-Wesley, 2004, ISBN 0-201-69947-8.

(COLLIS; HUSSEY, 2009) COLLIS, J.; HUSSEY, R. **Business research: A practical guide for undergraduate and postgraduate students.** Palgrave MacMillan, UK, 2009, ISBN 9781403992475.

(CONSTANTINE, 2002) CONSTANTINE, L. L. **Process agility and software usability: Toward lightweight usage-centered design**. Information Age, v. 8, n. 8, p. 1-10, 2002.

(COOPER, 1999) COOPER, A. **Inmates Are Running the Asylum**, **The: Why High-Tech Products Drive Us Crazy and How to Restore the Sanity.** Sams (1999).

(CURCIO et al., 2018) CURCIO, K.; NAVARRO, T.; MALUCELLI, A.; REINEHR, S. **Requirements engineering: a systematic mapping study in agile software development**. Journal of Systems and Software, 2018, vol. 139, p. 32-50.

(CURCIO et al., 2019) CURCIO, K.; SANTANA, R.; REINEHR, S.; MALUCELLI, A. **Usability in agile software development: A tertiary study**. Computer Standards & Interface, vol. 64, p. 61-77, 2019.

(DAVIS, 1989) DAVIS, F. **Perceived usefulness, perceived ease of use, and user acceptance of information technology.** MIS Quarterly, v. 13, no. 3, p. 319–340, 1989.

(DHANDAPANI, 2015) DHANDAPANI, S**. Literature Review1**, in: 2015 Int. Conf. Data Softw. Eng., 2015: pp. 37–41.

(DIGITAL.AI, 2021) DIGITAL.AI. **15th Annual State of Agile Report – Agile adoption accelerates across the enterprise.** Available at: https://stateofagile.com/#ufh-i-661275008-15th-state-of-agile-report/7027494. Accessed on August 16, 2021.

(DINGSØYR; DYBÅ; MOE, 2010) DINGSØYR, T.; DYBÅ, T.; MOE, N.B. **Agile Software Development: Current Research and Future Directions**, 1, Springer-Verlag, Berlin Heidelberg, 2010.

(DINGSØYR et al., 2012) DINGSØYR, T.; NERUR, S.; BALIJEPALLY, V.; MOE, N.B. **A decade of agile methodologies: Towards explaining agile software development.** J. Syst. Softw. 85, 1213– 1221, 2012.

(EISENHARDT, 1989) EISENHARDT, K. Building Theories from Case Study Research. Academy of Management Review. Vol. 14. No. 4. pp. 532-550, 1989. DOI: 10.5465/AMR.1989.4308385

(ENDMANN; KEßNER, 2016) ENDMANN, A.; KEßNER, D. **User Journey Mapping – A Method in User Experience Design**. i-com., v. 15, n. 1, p. 105-110, 2016.

(FERREIRA; NOBLE; BIDDLE, 2007b) FERREIRA, J.; NOBLE, J.; BIDDLE, R. **Interaction designers on eXtreme Programming teams: Two case studies from the real world.** In 5th New Zealand Computer Science Research Student Conference, 2007, pp. 1-8.

(FERREIRA; SHARP; ROBINSON, 2010) FERREIRA, J.; SHARP, H.; ROBINSON, H. "**Values and assumptions shaping agile development and user experience design in practice**". In XP, 2010, pp. 178–183.

(FOX; SILLITO; MAURER, 2008) FOX, D.; SILLITO, J.; MAURER, F. **Agile Methods and User-Centered Design: How These Two Methodologies are Being Successfully Integrated in Industry**. Agile 2008 Conference, pp. 63–72, 2008.

(GANCI; RIBEIRO, 2014) GANCI, A.; RIBEIRO, B. **Becoming a team player: The evolving role of design in the world of agile development**. In Intern. Journal of Design Management and Professional Practice, vol. 7, no. 2, pp. 11-23, 2014.

(GARCIA; SILVA; SILVEIRA, 2017) GARCIA, A.; SILVA, T.; SILVEIRA, M. **Artifacts for Agile User-Centered Design: A Systematic Mapping.** Proceedings of the Annual Hawaii International Conference on System Sciences, pp. 5859 – 5868.

(GARRETT, 2011) GARRETT, J. **The Elements of User Experience: User Centered Design for the Web and Beyond**. New Riders. 38, 408, 415, 416.

(GONÇALVES; SANTOS, 2011) GONÇALVES, J.; SANTOS, C. **POLVO - Software for prototyping of low-fidelity interfaces in agile development**. In Lecture Notes in Computer Science, vol. 6761 LNCS, no. 1, pp. 63-71, 2011.

(GOTHELF; SEIDEN, 2013) GOTHELF, J.; SEIDEN, J. **Lean UX: Applying lean principles to improve user experience**. O'Reilly, 2013.

(HAIKARA, 2007) HAIKARA, J. **Usability in Agile Software Development: Extending the Interaction Design Process with Personas Approach**. In XP'07: Proceedings of the 8th International Conference on Agile Processes In Software Engineering And Extreme Programming, 2007, pp. 153-156.

(HUMAYOUN; DUBINSKI; CATARCI, 2011) HUMAYOUN, S.; DUBINSKI, Y.; CATARCI, T**. A three-fold integration framework to incorporate user-centered design into agile software development**. In Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), vol. 6776 LNCS, pp. 55-64, 2011.

(INAYAT et al., 2015) INAYAT, I., SALIM, S.S., MARCZAK, S., DANEVA, M., SHAMSHIRBAND, S. **A systematic literature review on agile requirements engineering practices and challenges**. Comput. Hum. Behav. 51, 2015.

(ISO/IEC 9126, 1991) INTERNATIONAL ORGANIZATION FOR STANDARDIZATION/ INTERNATIONAL ELECTROTECHNICAL COMISSION. **ISO/IEC 9126-1 - Software Engineering – Product Quality.** Geneva, Switzerland, 1991.

(ISO/IEC 9126-1, 2001) INTERNATIONAL ORGANIZATION FOR STANDARDIZATION/ INTERNATIONAL ELECTROTECHNICAL COMISSION. **ISO/IEC 9126-1 - Software Engineering – Product Quality – Part 1: Quality Model.** Geneva, Switzerland, 2001.

(ISO/IEC TR 9126-2, 2003) INTERNATIONAL ORGANIZATION FOR STANDARDIZATION/ INTERNATIONAL ELECTROTECHNICAL COMISSION. **ISO/IEC TR 9126-2 - Software Engineering – Product Quality – Part 2: External Metrics.** Geneva, Switzerland, 2003.

(ISO/IEC TR 9126-3, 2003) INTERNATIONAL ORGANIZATION FOR STANDARDIZATION/ INTERNATIONAL ELECTROTECHNICAL COMISSION. **ISO/IEC TR 9126-3 - Software Engineering – Product Quality – Part 3: Internal Metrics.** Geneva, Switzerland, 2003.

(ISO/IEC TR 9126-4, 2004) INTERNATIONAL ORGANIZATION FOR STANDARDIZATION/ INTERNATIONAL ELECTROTECHNICAL COMISSION.

ISO/IEC TR 9126-4 - Software Engineering – Product Quality – Part 4: Quality in Use Metrics. Geneva, Switzerland, 2004.

(ISO 9241-10, 1996) INTERNATIONAL ORGANIZATION FOR STANDARDIZATION. **ISO 9241-11:1996 Ergonomic requirements for office work with visual display terminals (VDTs) -- Part 10: Dialogue principles.** Geneva, Switzerland, 1996.

(ISO 9241-11, 1998) INTERNATIONAL ORGANIZATION FOR STANDARDIZATION. **ISO 9241-11:1998 Ergonomics requirements for office work with visual display terminals (VDTs) -- Part 11: Guidance on usability.** Geneva, Switzerland, 1998.

(ISO 9241-11, 2018) INTERNATIONAL ORGANIZATION FOR STANDARDIZATION. **ISO 9241-11:2018 Ergonomics of human-system interaction – Part 11: Usability: Definitions and Scope.** Geneva, Switzerland, 2018.

(ISO 9241-12, 1998) INTERNATIONAL ORGANIZATION FOR STANDARDIZATION. **ISO 9241-12:1998 Ergonomic requirements for office work with visual display terminals (VDTs) -- Part 12: Presentation of information.** Geneva, Switzerland, 1998.

(ISO 9241-13, 1998) INTERNATIONAL ORGANIZATION FOR STANDARDIZATION. **ISO 9241-13:1998 Ergonomic requirements for office work with visual display terminals (VDTs) -- Part 13: User guidance.** Geneva, Switzerland, 1998.

(ISO 9241-14, 1997) INTERNATIONAL ORGANIZATION FOR STANDARDIZATION. **ISO 9241-14:1997 Ergonomic requirements for office work with visual display terminals (VDTs) -- Part 14: Menu dialogues.** Geneva, Switzerland, 1997.

(ISO 9241-15, 1997) INTERNATIONAL ORGANIZATION FOR STANDARDIZATION. **ISO 9241-15:1997 Ergonomic requirements for office work with visual display terminals (VDTs) -- Part 15: Command dialogues.** Geneva, Switzerland, 1997.

(ISO 9241-16, 1999) INTERNATIONAL ORGANIZATION FOR STANDARDIZATION. **ISO 9241-16:1999 Ergonomic requirements for office work with visual display terminals (VDTs) -- Part 16: Direct manipulation dialogues.** Geneva, Switzerland, 1999.

(ISO 9241-17, 1998) INTERNATIONAL ORGANIZATION FOR STANDARDIZATION. **ISO 9241-17:1998 Ergonomic requirements for office work with visual display terminals (VDTs) -- Part 17: Form filling dialogues.** Geneva, Switzerland, 1998.

(ISO 9241-110, 2006) INTERNATIONAL ORGANIZATION FOR STANDARDIZATION. **ISO 9241-110:2006 Ergonomics of human-system interaction -- Part 110: Dialogue principles.** Geneva, Switzerland, 2006.

(ISO 9241-125, 2017) INTERNATIONAL ORGANIZATION FOR STANDARDIZATION**. ISO 9241-125:2017 Ergonomics of human-system interaction -- Part 125: Guidance on visual presentation of information.** Geneva, Switzerland, 2017.

(ISO 9241-143, 2012) INTERNATIONAL ORGANIZATION FOR STANDARDIZATION**. ISO 9241-143:2012 Ergonomics of human-system interaction -- Part 143: Forms.** Geneva, Switzerland, 2012.

(ISO 9241-143, 2012) INTERNATIONAL ORGANIZATION FOR STANDARDIZATION. **ISO 9241-143:2012 Ergonomics of human-system interaction -- Part 143: Forms.** Geneva, Switzerland, 2012.

(ISO 9241-210, 2010) INTERNATIONAL ORGANIZATION FOR STANDARDIZATION. **ISO 9241-210: Ergonomics of Human–System Interaction – Part 210: Human-Centred Design Process for Interactive.** Geneva, Switzerland, 2010.

(ISO 9241-210, 2019) INTERNATIONAL ORGANIZATION FOR STANDARDIZATION**. ISO 9241-210:2019 Ergonomics of human-system interaction – Part 210: Human-centred design for interactive systems.** Geneva, Switzerland, 2019.

(ISO 13407, 1999) INTERNATIONAL ORGANIZATION FOR STANDARDIZATION. **ISO 13407: Human-centred design processes for interactive systems.** Geneva, Switzerland, 1999.

(ISO/TR 18529, 2000) INTERNATIONAL ORGANIZATION FOR STANDARDIZATION. **ISO 18529: Ergonomics of human-system interaction – Human-centred lifecycle process descriptions.** Geneva, Switzerland, 2000.

(ISO/IEC 25000, 2014) INTERNATIONAL ORGANIZATION FOR STANDARDIZATION/ INTERNATIONAL ELECTROTECHNICAL COMISSION. **ISO/IEC 25000 – Systems and Software Engineering – Systems and software Quality Requirements and Evaluation (SQuaRE) -- Guide to SQuaRE**. Geneva, Switzerland, 2014.

(ISO/IEC 25010, 2011) INTERNATIONAL ORGANIZATION FOR STANDARDIZATION/ INTERNATIONAL ELECTROTECHNICAL COMISSION. **ISO/IEC 25010 – System and software Engineering – System and software Quality Requirements and Evaluation (SQuaRE) – System and software quality models.** Geneva, Switzerland, 2011.

(ISO/IEC 25020, 2007) INTERNATIONAL ORGANIZATION FOR STANDARDIZATION/ INTERNATIONAL ELECTROTECHNICAL COMISSION. **ISO/IEC 25020 – Software Engineering – Software product Quality Requirements and Evaluation (SQuaRE) – Measurement reference model and guide.** Geneva, Switzerland, 2007.

(ISO/IEC 25022, 2016) INTERNATIONAL ORGANIZATION FOR STANDARDIZATION/ INTERNATIONAL ELECTROTECHNICAL COMISSION. **ISO/IEC 25022: 2016 – Systems and Software Engineering – Systems and Software Quality Requirements and Evaluation (SQuaRE) – Measurement of quality in use.** Geneva, Switzerland, 2016.

(ISO/IEC 25030, 2007) INTERNATIONAL ORGANIZATION FOR STANDARDIZATION/ INTERNATIONAL ELECTROTECHNICAL COMISSION. **ISO/IEC 25030 – Software Engineering – Software product Quality Requirements and Evaluation (SQuaRE) – Quality requirements.** Geneva, Switzerland, 2007.

(ISO/IEC 25040, 2011) INTERNATIONAL ORGANIZATION FOR STANDARDIZATION/ INTERNATIONAL ELECTROTECHNICAL COMISSION. **ISO/IEC 25040 – System and software Engineering – System and software Quality Requirements and Evaluation (SQuaRE) – Evaluation process.** Geneva, Switzerland, 2011.

(JURCA; HELLMANN; MAURER 2014) JURCA, G.; HELLMANN, T.D.; MAURER, F. **Integrating agile and user-centered design: A systematic mapping and review of evaluation and validation studies of agile-UX**. Proc. - 2014 Agil. Conf. Agil. 2014. (2014) 24–32.

(KAPLAN, 2016) KAPLAN, K. **When and How to create Customer Journey Maps**. Available at: <https://www.nngroup.com/articles/customer-journey-mapping/>. Accessed on September 9, 2018.

(KITCHENHAM; CHARTERS, 2007) KITCHENHAM, B.A; CHARTERS, S. **Guidelines for performing Systematic Literature Reviews in Software Engineering**. Keele University and Durham University, Technical Report EBSE 2007-001, Version 2.3.

(KNAPP; ZERATSKY; KOWITZ, 2016) KNAPP, J.; ZERATSKY, J.; KOWITZ, B. **Sprint: How to solve big problems and test new ideas in just five days.** Simon and Schuster, 2016.

(KUROSU, 2019) KUROSU, M. **Nigel Bevan and concepts of usability, ux, and satisfaction**, Journal of Usability Studies, vol. 14, no. 3, 2019.

(KUUSINEN, 2016) KUUSINEN, K. **BoB: A framework for organizing within-iteration UX work in agile development**. In: Integrating User-Centred Design in Agile Development. Springer, Cham, 2016. p. 205-224.

(LARUSDOTTIR; GULLIKSEN; CAJANDER, 2016) LARUSDOTTIR, M.; GULLIKSEN, J.; CAJANDER, A. **A license to kill – Improving UCSD in Agile development**. Journal of Systems and Software, vol. 123, pp. 214-222. 2017.

(LAW et al., 2008) LAW, E.; ROTO, V.; VERMEEREN, A.; KORT, J.; HASSENZAHL, M. **Towards a Shared Definition of User Experience**. In CHI ’08 Extended Abstracts on Human Factors in Computing Systems, CHI EA ’08, New York, NY, USA, pp. 2395–2398. ACM. 37.

(LEE; STEVENS; MCCRICKARD, 2009) LEE, J. C.; STEVENS, K. T.; MCCRICKARD, D. S. **Examining the foundations of agile usability with eXtreme Scenario-based Design**. In Proc. Agile 2009, IEEE Computer Society (2009), 3-10.

(LIEVESLEY; YEE, 2006) LIEVESLEY, M.; YEE, J. **The role of the interaction designer in an agile software development process**. In Conference on Human Factors in Computing Systems, 2006, pp. 1025-1030.

(LIIKKANEN et al., 2014) LIIKKANEN, L. A.; KILPIÖ, H.; SVAN, L.; HILTUNEN, M. **Lean UX**. Proceedings of the 8th Nordic Conference on Human-Computer Interaction Fun, Fast, Foundational - NordiCHI ’14.

(MAGÜES; CASTRO; ACUÑA, 2016a) MAGÜES, D.A.; CASTRO, J.W.; ACUÑA, S.T. **Usability in agile development: a systematic mapping study**. In: Proc. XLII Conf. Latinoam. Informatica, 2016.

(MAGÜES; CASTRO; ACUÑA, 2016b) MAGÜES, D.A.; CASTRO, J.W.; ACUÑA, S.T., **HCI usability techniques in agile development**, in: 2016 IEEE Int. Conf. Autom., 2016: pp. 1–7.

(MCINERNEY; MAURER, 2005) MCINERNEY, P.; MAURER, F. **UCD in Agile Projects: Dream Team or Odd Couple? ,** interactions, v. 12, n. 6, p. 19-23, 2005.

(MCT, 2009) MINISTÉRIO DA CIÊNCIA E TECNOLOGIA. **Pesquisa de Qualidade no Setor de Software Brasileiro**. 176 p. Disponível em <http://www.mct.gov.br/upd_blob/0210/ 210931.pdf> Acesso em 4 fev. 2011.

(MILLER, 2005) MILLER, L. **Case study of customer input for a successful product**. In: Proceedings of the Agile Conference ’05. IEEE Computer Society, 2005. pp 225–234.

(MINGE et al., 2016) MINGE, M.; THURING, M.; WAGNER, I.; KUHR, C.V. **The meCUE Questionnaire. A Modular Evaluation Tool for Measuring User Experience**. In M. Soares, C. Falcão & T.Z. Ahram (EDS.): Advances in Ergonomics Modeling, Usability & Special Populations. Proceedings of the 7th Applied Human Factors and Ergonomics Society Conference 2016. Switzerland: Springer International Press, pp. 115-128.

(NAJAFI; TAYOSHIBA, 2008) NAJAFI, M.; TOYOSHIBA, L. **Two Case Studies of User Experience Design and Agile Development**. Agile 2008 Conference. pp. 531–536. IEEE Press (2008).

(NIELSEN, 1993) NIELSEN, J. **Usability Engineering**. Morgan Kaufman Publisher, Academic Press, 1993.

(NIELSEN, 2012) NIELSEN, J. **Usability 101: Introduction to Usability**. Available at:<https://www.nngroup.com/articles/usability-101-introduction-to-usability/>. Accessed on September 13, 2018.

(NIELSEN, 2019a) NIELSEN, L. **Encyclopedia of Human-Computer Interaction 2rd Edition**. The Interaction Design Foundation. Available at: <https://www.interaction-design.org/literature/book/the-encyclopedia-of-human-computer-interaction-2nd-ed/personas>. Accesses on July 27, 2021.

(NIELSEN, 2019b) NIELSEN, L. **Personas Go Agile. In: Personas - User Focused Design. Human–Computer Interaction Series**. Springer, London, 2019. https://doi.org/10.1007/978-1-4471-7427-1_6

(OBENDORF; FINCK, 2008) OBENDORF, H.; FINCK, M. **Scenario-Based Usability Engineering Techniques in Agile Development Processes**. Proceedings CHI EA'08 CHI'08, New York, April 2008, pp. 2159-2166.

(OSTERWALDER; PIGNEUR; CLARK, 2010) OSTERWALDER, A.; PIGNEUR, Y.; CLARK, T. **Business Model Generation,** Hoboken, NJ: Wiley.

(OSTERWALDER et al., 2014) OSTERWALDER, A.; PIGNEUR, Y.; BERNARDA, G.; SMITH, A. **Value proposition design: How to create products and services customers want,** Hoboken, JA: John Wiley & Sons, Inc.

(PALMER; FELSING, 2002) PALMER, S.R.; FELSING, J.M. **A Practical Guide to Feature-driven Development**, Prentice Hall, Upper Saddle River, NJ, 2002, ISBN 0- 13-067615-2.

(PATTON; ECONOMY, 2014) PATTON, J.; ECONOMY, P. **User Story Mapping: Discover the Whole Story, Build the Right Product**. 1st edn. O'Reilly Media Inc., 2014.

(PATTON, 2017) PATTON, J. **Dual Track Development is not Duel Track**. Available at: https://jpattonassociates.com/dual-track-development/. Accessed on September 25, 2018.

(PLONKA et al., 2014) PLONKA, L.; SHARP, H.; GREGORY, P.; TAYLOR, K. **UX design in agile: A DSDM case study.** In Lecture Notes in Business Information Processing, vol. 179 LNBIP, pp. 1-15, 2014.

(POPPENDIECK; POPPENDIECK, 2003) POPPENDIECK, M.; POPPENDIECK, T. **Lean Software Development – An Agile Toolkit for Software Development Managers**, Addison-Wesley, Boston, 2003, ISBN 0-321-15078-3.

(PREECE; ROGERS; SHARP, 2002) PREECE, J.; ROGERS, Y.; SHARP, H. **Interaction Design: Beyond Human Computer Interaction (1st ed.)**. John Wiley & Sons, 2002.

(PREECE; ROGERS; SHARP, 2019) PREECE, J.; ROGERS, Y.; SHARP, H. **Interaction Design: Beyond Human Computer Interaction (5th ed.).** John Wiley & Sons, 2002.

(REINEHR, 2008) REINEHR, S. S. **Reuso Sistematizado de Software e Linhas de Produto de Software no Setor Financeiro: Estudos de Caso no Brasil**. 2008, Tese (Doutorado) – Escola Politécnica, Universidade São Paulo (USP), São Paulo, 2008.

(RIES, 2011) RIES, E. **The Lean Startup: How Today's Entrepreneurs Use Continuous innovation to Create Radically Successful Business**. United States of America: Crown Business. ISBN 978-0-307-88789-4.

(ROSSON; CARROLL, 2002) ROSSON, M. B.; CARROLL, J. M. **Usability Engineering: Scenario-Based Development of Human-Computer Interaction**. Morgan Kaufman, New York, NY, USA, 2002.

(SANTOS; KON, 2011) SANTOS, A.P.O.D., KON, F. **Applying Usability and User Experience Goals in Agile Software Development.** In XP'2011 - Proceedings of the 2nd workshop Dealing with Usability in an Agile Domain. Madrid, Spain. 91, 368, 2011.

(SALAH; PAIGE; CAIRNS, 2014) SALAH, D.; PAIGE, R. F.; CAIRNS, P. **A systematic literature review for agile development processes and user centred design integration**, Proc. 18th Int. Conf. Eval. Assess. Softw. Eng. - EASE '14. (2014) 1–10.

(SALAH; PAIGE; CAIRNS, 2015) SALAH, D.; PAIGE, R. F.; CAIRNS, P. **Patterns for integrating agile development processes and user centred design.** In: Proceedings of the 20th European Conference on Pattern Languages of Programs. ACM, 2015. p. 19.

(SALVADOR; NAKASONE; POW-SANG, 2014) SALVADOR, C.; NAKASONE, A.; POW-SANG, J.A. **A systematic review of usability techniques in agile methodologies**, Proc. 7th Euro Am. Conf. Telemat. Inf. Syst. - EATIS '14. (2014) 1–6.

(SCHWABER; BEEDLE, 2001) SCHWABER, K.; BEEDLE, M. **Agile Software Development with Scrum**, Prentice Hall, Upper Saddle River, NJ, USA, 2001.

(SCHWABER; SUTHERLAND, 2017) SCHWABER, K.; SUTHERLAND, J. **The Scrum guide - The definitive guide to Scrum: the rules of the game**, Available at: <https://www.scrumguides.org/docs/scrumguide/v2017/2017-Scrum-Guide-US.pdf#zoom=100>. Accessed on December 14, 2017.

(SHNEIDERMAN, 2005) SHNEIDERMAN, B. **Eight Golden Rules of Interface Design**. Available at:<https://www.cs.umd.edu/users/ben/goldenrules.html>. Accesses on September 8, 2018.

(SHANKAR et al., 2015) SHANKAR, A.; LIN, H.; BROWN, H.-F.; RICE, C. **Rapid Usability Assessment of an Enterprise Application in an Agile Environment with CogTool**. In Proceedings of the 33rd Annual ACM Conference Extended Abstracts on Human Factors in Computing Systems, New York, NY, USA: ACM, 2015, pp. 719-726.

(SILVA et al., 2011) SILVA, T.S.D.; MARTIN, A.; MAURER, F.; SILVEIRA, M. **User-centered design and agile methods: A Systematic review**. Proc. - 2011 Agil. Conf. Agil. 2011. (2011) 77–86.

(SILVA et al., 2013) SILVA, T.S.D; SILVEIRA, M. S.; MELO, C.D.O.; PARZIANELLO, L.C. **Understanding the UX Designer's Role within Agile Teams**. In Design, User Experience, and Usability. Design Philosophy, Methods, and Tools, Springer, Berlin/Heidelberg, 2013, pp. 599-609.

(SILVA et al., 2015) SILVA, T.S.D.; SILVEIRA, F.F., SILVEIRA, M.S., HELLMANN, T., MAURER, F. **A Systematic Mapping on Agile UCD Across the Major Agile and HCI Conferences**. In: O. Gervasi, B. Murgante, S. Misra, M.L. Gavrilova, A.M.A.C. Rocha, C. Torre, D. Taniar, B.O. Apduhan (Eds.), Comput. Sci. Its Appl. -- ICCSA 2015, Springer International Publishing, Cham, 2015: pp. 86–100.

(SILVA; SILVEIRA; MAURER, 2015) SILVA, T.S.D.; SILVEIRA, S.M.; MAURER, F.: **Usability evaluation practices within agile development**. In: System Sciences (HICSS), 2015 48th Hawaii International Conference on, IEEE (2015) 5133–5142.

(SILVA et al., 2018) SILVA, T.S.D; SILVEIRA, M.S.; MAURER, F.; SILVEIRA, F.F. **The evolution of agile UXD**. Information and Software Technology. 102 (2018) 1–5.

(SOHAIB; KHAN, 2010) SOHAIB, O.; KHAN, K. **Integrating usability engineering and agile software development: A literature review**, in: 2010 Int. Conf. Comput. Des. Appl., 2010: pp. V2-32-V2-38.

(STAPLETON, 2003) STAPLETON, J. **DSDM: Business Focused Development**, second ed., Pearson Education, 2003, ISBN 978- 0321112248.

(SY, 2007) SY, D. **Adapting Usability Investigations for Agile User-Centered Design.** Journal of Usability Studies, vol. 2, no. 3, pp. 112-132, 2007.

(TULLIS; ALBERT, 2013) TULLIS, T.; ALBERT, W. **Measuring the User Experience**, Meas. User Exp. (2013) 320.

(UNGER, CHANDLER, 2012) UNGER, R.; CHANDLER, C. **A Project Guide to UX Design: For user experience designers in the field or in the marketing**. Second ed. New Riders, 2012.

(UXPA, 2018) UXPA International. UX Salary Survey 2018. Available at: <https://uxpa.org/wp-content/uploads/sites/9/2017/10/UXPA_SalarySurvey_2018v4.pdf> Accesses on July 27, 2021.

(VIVIANO, 2014) VIVIANO, A. **The Lean UX Manifesto: Principle-Driven Design**. Available at: <http://www.smashingmagazine.com/2014/01/08/lean-ux-manifesto-principle-driven-design/>. Accesses on February 9, 2019.

(ZAPATA, 2015) ZAPATA, C., **Integration of Usability and Agile Methodologies: A Systematic Review.** In: A. Marcus (Ed.), Des. User Exp. Usability Des. Discourse, Springer International Publishing, Cham, 2015: pp. 368–378.

(YIN, 2009) YIN, R. K. **Case study research: design and methods**. 4 th ed. p. cm.-(Applied social research methods v. 5), 2009.

(WALE-KOLADE; NIELSEN; PÄIVÄRINTA, 2013) WALE-KOLADE, A.; NIELSEN, P.A.; PÄIVÄRINTA,T. **Usability Work in Agile Systems Development Practice: A Systematic Review**, in: H. Linger, J. Fisher, A. Barnden, C. Barry, M. Lang, C. Schneider (Eds.), Build. Sustain. Inf. Syst., Springer US, Boston, MA, 2013: pp. 569–582.

(WINTER; HOLTE-M; THOMASCHEWSKI, 2012) WINTER D.; HOLT E-M.; THOMASCHEWSKI J., **Persona driven agile development—build up a vision with personas, sketches and persona driven user stories**. In: Proceedings of the 7th Conference on Information Systems and Technologies (CISTI), 2012.

(WOHLIN; AURUM, 2015) WOHLIN, C.; AURUM A. **Towards a decision-making structure for selecting a research design in empirical software engineering**, Empir. Software Eng. 20, 1427–1455 (2015). https://doi.org/10.1007/s10664-014-9319-7

APPENDIX A – SEMI-STRUCTURED INTERVIEW

PONTOS DE ANÁLISE	PERGUNTAS
PA-01	- Existe alguma iniciativa da organização para a alocação de recursos especialistas em usabilidade ou experiência do usuário na formação dos times de desenvolvimento ágil? - Como os especialistas são envolvidos nos projetos de desenvolvimento de software? - Os especialistas trabalham nos mesmos times de desenvolvimento dos produtos de software ou são alocados separadamente sob demanda?
PA-02	- Existe alguma ferramenta utilizada pelo time de desenvolvimento que auxilie a integração da usabilidade ao desenvolvimento do produto de software? - Quais são elas e em que fase do projeto elas são utilizadas? - De que forma essas ferramentas auxiliam o desenvolvimento do produto de software?
PA-03	- A organização desenvolve software para diversos tipos de plataformas? Quais são elas? - Os processos de desenvolvimento estabelecidos atendem à todas as plataformas? - Existe alguma plataforma na qual a organização entenda que seja necessário trabalhar mais fortemente a usabilidade do projeto? Por quê?
PA-04	- A organização possui algum processo estabelecido para o desenvolvimento de software? - Existe alguma prática e/ou processo utilizada na organização específica para a integração de usabilidade em projetos ágeis? - Como essas práticas e ou processos são realizados? - Quais artefatos são gerados com os resultados da realização dessas práticas e/ou processo específicos para a integração de usabilidade em projetos ágeis?
PA-05	- Existe alguma iniciativa na organização para a promoção do conhecimento na área de usabilidade e/ou experiência do usuário? - A equipe técnica foi treinada para ter conhecimento nessas áreas? - A organização possui uma política que fomente o treinamento nessa área? - Os profissionais acreditam que o treinamento nessa área será útil para a melhoria da qualidade do produto? - A organização possui alguma metodologia de desenvolvimento de software que inclua alguma prática de usabilidade?
PA-06	- A alta gerência da organização apoia a criação e a implantação de políticas que fomentam a integração do desenvolvimento de software ágil e usabilidade? - A alta gerência considera a usabilidade como uma forma de agregar valor ao produto de software?
PA-07	- A empresa reserva recurso organizacional para investimento em treinamento do corpo técnico na área de usabilidade? - A empresa reserva recurso organizacional para investimento em

	treinamento do corpo técnico na área de desenvolvimento ágil?
PA-08	- Existe na organização uma tendência em priorizar a entrega de software funcional, em um curto espaço de tempo, em detrimento da usabilidade? - Em caso positivo, quais seriam os fatores que levam a essa priorização? - Existe uma preocupação do corpo técnico em se integrar a usabilidade ao desenvolvimento ágil de software? - O corpo técnico considera importante para a qualidade do produto final a integração da usabilidade ao desenvolvimento do software?
PA-09	- O corpo técnico realiza algum tipo de prototipação das telas do sistema, seja em papel ou ferramentas mockups? - O corpo técnico realiza a prototipação das telas de todo o sistema (BDUF - Big Design Up Front) antes do início da implementação? - Quanto tempo (proporcionalmente ao timebox) é dedicado a essa atividade?
PA-10	- O corpo técnico executa testes unitários nos softwares desenvolvidos? - O corpo técnico executa testes de usabilidade nos softwares desenvolvidos? - Em caso positivo, quais testes de usabilidade são realizados? - A organização possui métricas para a medição e o acompanhamento da usabilidade? - Como essas métricas são coletadas? - De que forma essas métricas contribuem para a qualidade do produto final?
PA-11	- No processo de desenvolvimento da organização existe uma fase específica para o levantamento e reconhecimento de todos os usuários que utilizarão o sistema? - Os usuários do sistema são envolvidos no processo de desenvolvimento? - Em caso positivo, de que forma eles são envolvidos? - A opinião desses usuários afeta a priorização das demandas a serem desenvolvidas? - A opinião desses usuários afeta a forma como o sistema é desenvolvido?

APPENDIX B – RESEARCH PROTOCOL – RESEARCH SCOPE OVERVIEW

CENÁRIO DE INSERÇÃO:

Pesquisa de tese de doutorado realizada por Karina Paula de Camargo Curcio, na Pontifícia Universidade Católica do Paraná, Programa de Pós Graduação em Informática (PPGIa), Grupo de Pesquisa de Engenharia de Software (GPES), sob a orientação da professora Andreia Malucelli e co-orientação da professora Sheila Reinehr.

QUESTÃO QUE A PESQUISA VISA RESPONDER:

Como a usabilidade está sendo integrada ao desenvolvimento ágil de software e quais são as dificuldades associadas a esta integração?

OBJETIVO DO ESTUDO DE CASO:

Coletar informações na Empresa Participante para compor o mapeamento da situação de como a usabilidade está integrada ao desenvolvimento ágil de software e quais são as principais dificuldades associadas a esta integração.

PÚBLICO ALVO (EMPRESAS):

Empresas de desenvolvimento de software, públicas ou privadas, nacionais ou estrangeiras, que utilizem metodologias ou frameworks de desenvolvimento ágil.

FORMA DE EXECUÇÃO:

Entrevistas semi-estruturadas realizadas presencialmente na empresa.

DELIMITAÇÃO DE ESCOPO:

O foco principal da pesquisa é investigar a usabilidade em empresas de desenvolvimento de software que utilizem metodologias ou frameworks de

desenvolvimento ágil (Ex.: Scrum, eXtreme Programming (XP) etc.). Empresas que utilizem outras abordagens não fazem parte do escopo desta pesquisa.

CONFIDENCIALIDADE DAS INFORMAÇÕES:

Nenhuma informação individualizada por empresa será divulgada, a menos que expressamente por ela autorizada. Nenhuma informação coletada durante as entrevistas será comentada ou divulgada a não ser de forma agregada e não caracterizável.

PÚBLICO ALVO (PAPÉIS):

Gerente de Desenvolvimento de Sistemas: gerente que tem sob a sua responsabilidade as equipes de desenvolvimento de sistemas ligados diretamente ao negócio da empresa. Geralmente tem perfil mais gerencial e encontra-se mais próximo das decisões estratégicas do que dia a dia dos analistas.

Coordenador de Desenvolvimento: coordenador que tem sob a sua responsabilidade sistemas relacionados diretamente ao negócio da empresa. Geralmente tem perfil mais técnico e encontra-se mais próximo do dia a dia dos analistas.

Product Owner: profissional que faz parte do time Scrum (framework de desenvolvimento ágil) responsável por definir e priorizar os requisitos (estórias de usuários), mantendo a integridade conceitual das novas funcionalidades.

Scrum Master: profissional que faz parte do time Scrum (framework de desenvolvimento ágil) e atua como facilitador, responsável por remover obstáculos encontrados durante o processo de desenvolvimento.

Analista de Sistemas: profissional ou equipe de profissionais responsáveis pelo levantamento e documentação dos requisitos de um ou mais sistemas diretamente relacionados ao negócio da organização.

Desenvolvedor: profissional responsável pelo desenvolvimento e manutenção de um ou mais sistemas diretamente relacionados ao negócio na organização.

Testador: profissional responsável pela realização de testes e documentação das avaliações nos sistemas desenvolvidos na organização.

Designer (ou equivalente): profissional que tem sob sua responsabilidade a criação das interfaces de acessos aos sistemas desenvolvidos pela organização para garantir uma experiência amigável.

QUESTÕES DE EMBASAMENTO (VISÃO GERAL):

- Como ocorre o planejamento e a implementação da usabilidade nos produtos de software?
- Quais são as maiores dificuldades que a empresa encontra para tratar a usabilidade?
- Como estas atividades estão relacionadas com os princípios do desenvolvimento ágil adotado na empresa?

APPENDIX C – RESEARCH PROTOCOL – COVER LETTER

Curitiba, <DIA> de <MÊS> de <ANO>.

À <ORGANIZAÇÃO>

At. Sr. <RESPONSÁVEL ORGANIZAÇÃO>

Prezado Senhor,

Venho, através desta, solicitar a sua autorização para a condução de um estudo de campo da tese de doutorado da aluna **Karina Paula de Camargo Curcio**, que está sendo desenvolvida sob minha orientação com co-orientação da professora Sheila Reinehr e colaboração do professor Frederick van Amstel no Programa de Pós Graduação em Informática da PUCPR, cujo título é: **"Integração de usabilidade ao desenvolvimento ágil de software"**.

O objetivo principal da pesquisa é investigar como a usabilidade é tratada no âmbito do desenvolvimento ágil de software, mapeando como ocorrem estes processos, quais são as principais dificuldades associadas e como a usabilidade contribui para o sucesso dos projetos de software, neste contexto.

A pesquisa será realizada por meio de entrevistas semiestruturadas, que visam coletar as informações necessárias para desenhar o panorama de integração da usabilidade no desenvolvimento ágil de software. O público alvo das entrevistas, bem como a duração prevista e as datas sugeridas, encontram-se no anexo desta carta.

Gostaria, ainda, de afirmar o nosso compromisso em relação à confidencialidade das informações prestadas. Todos os dados serão tratados de forma a preservar a privacidade, tanto dos entrevistados, quanto da instituição. Nenhuma informação personalizada será publicada, a menos que autorizado formalmente pela empresa. Um Termo de Confidencialidade será assinado pelos pesquisadores, com termos a critério da empresa.

Aguardamos o seu retorno e antecipadamente agradecemos pela colaboração.

Atenciosamente,

Andreia Malucelli, PHD
Programa de Pós Graduação em Informática - PPGIa
Pontifícia Universidade Católica do Paraná

APPENDIX D – RESEARCH PROTOCOL – NON-DISCLOSURE TERMS

TERMO DE CONFIDENCIALIDADE

Este Termo de Confidencialidade visa estabelecer um acordo entre os pesquisadores Karina Paula de Camargo Curcio, Andreia Malucelli, Frederick van Amstel e Sheila Reinehr, doravante denominados Pesquisadores, e <NOME DA ORGANIZAÇÃO>, doravante denominada Empresa Participante, a respeito da confidencialidade das informações coletadas durante o processo de pesquisa da tese de doutorado da primeira, intitulado: "**Integração de usabilidade ao desenvolvimento ágil de software**".

Por meio deste Termo de Confidencialidade, os Pesquisadores se comprometem a:

- Portar-se com discrição em todos os momentos da pesquisa acadêmica, não comentando ou divulgando qualquer tipo de informação que tenha sido repassada de forma oral ou escrita.
- Não divulgar o nome da Empresa Participante, em qualquer meio, a menos que expressamente autorizado por esta.
- Não divulgar, em qualquer meio, os dados e informações individualizados coletados durante o processo de pesquisa na Empresa Participante.
- Divulgar, em formato de tese, artigos e apresentações, apenas os dados agregados, dos quais não se possa retirar ou inferir a identificação da Empresa Participante.
- Retornar para a Empresa Participante as informações coletadas e analisadas, em formato individualizado dos seus próprios dados e em formato agregado com os dados de todos os estudos de caso conduzidos.

As assinaturas abaixo expressam a concordância quanto ao cumprimento deste Termo de Confidencialidade, por prazo indeterminado.

Curitiba, <DIA> de <MÊS> de <ANO>.

_____	_____
Karina Curcio	Andreia Malucelli
_____	_____
Sheila Reinehr	Frederick van Amstel

APPENDIX E – Organization A – Analysis Points description

ANALYSIS POINTS	RESULTS
AP-01 – Usability specialists in the composition of agile development teams.	😐

During the interviews it was possible to detect that the composition of agile team is not always built with multidisciplinary profiles, including designer, UI designers, UX designers or web developers. The organization has a separate team of the development team composed of people with knowledge in the area of design and usability. Usually these professionals are allocated to development projects to work with user interface and user experience issues, however, since there are only 12 professionals across the company, not all projects are handled in this way. These professionals are usually allocated to work with business analysts or product owners to create prototypes and understand customer demands. They are usually allocated to do these activities during the “Sprint 0” to produce the artifacts for the development team.

ANALYSIS POINTS	RESULTS
AP-02 – Tools that help usability integration to software product development.	☺

The organization's teams of designers are using tools that help to create navigable prototypes, mockups, and screen patterns. Quant-UX[4] is often used for prototyping mobile applications. InVisio[5] and Figma[6] are used for low fidelity prototypes and layouts creation. According to the interviewees these tools helps the communication between the developers and the product users.

The company also provides a tool called Slack[7] that enables internal communication between employees and the exchange of information between them, including usability, UX concepts and knowledge.

[4] https://www.quant-ux.com/
[5] https://www.invisionapp.com/
[6] https://www.figma.com/
[7] https://slack.com

ANALYSIS POINTS	RESULTS
AP-03 – Focus of the integration of usability and agile software development for a specific type of development platform.	☹

The organization also develops software for different platforms, including mobile, desktop, totems, ATM's and tables. According to the interviewees there is no explicit dependence on the concern with usability and a specific platform. In some projects where the mobile applications will be most used, developers initiate the analysis and development with the mobile platform (called mobile first). However, this practice is only related to the concern about responsiveness, so that the same content used in the mobile application can be used in the web platform.

ANALYSIS POINTS	RESULTS
AP-04 - Practices and/or processes that combine the user-centered design approach with the agile software development, demonstrating the integration of usability to agile software development.	☺

This is a large organization that develops custom software. The company works with traditional and agile development methodology. This organization has defined its agile development process totally based on Scrum. They do not have a single product as the business focus. They usually attend different types of demands, customers from different areas. During the interviews was identified that the artifact most commonly developed by the designers are the navigable prototypes. They are used as an artifact to establish the communication with the final product users.

ANALYSIS POINTS	RESULTS
AP-05 – Knowledge in the area of usability.	☺

Despite of having only 12 professionals allocated to work with user interfaces and user experiences issues, we could notice that the organization stimulates the communication between the employees and the knowledge exchange. The company

provides a tool called Slack[8] that enables internal communication between employees and the exchange of information between them, including usability and UX concepts and knowledge. The organization encourages its employees to practice the Dojôs, where some employees can give lectures and training on a specific subject. This is a practice that facilitates the exchange of information and the continuous renewal of knowledge. The organization's professionals believe that training and ongoing usability research can help improve the quality of the final product.

ANALYSIS POINTS	RESULTS
AP-06 –Top management support in the creation and implementation of policies that foster the integration between agile software development and usability.	☹

According to the interviewees there is no policy within the organization that fosters the integration of usability within agile development. Top management agrees that concerns about usability issues are important, but it is not worked out and valued at the organization. The company's concern with the usability and user experience is still very recent in the company and top management mindset is still focused on the functional issues and to deliver value to the customer.

ANALYSIS POINTS	RESULTS
AP-07 – Organizational budget for investment in training of the technical staff for the integration of usability and agile software development.	☹

The organization allows several trainings in the area of software development and qualification of professionals, but there is no specific budget for investment in knowledge in the area of usability in agile development. There is a movement inside the company, carried out by the developers and designers themselves, to share knowledge internally within the organization. When a professional has some difficulty or is unaware of any tool, wikis are available to assist him, as well as chats tools (Slack) are used to facilitate communication and knowledge sharing.

[8] https://slack.com

ANALYSIS POINTS	RESULTS
AP-08 – Prioritization of the usability issues during software development.	☹

It was identified that, due to time and cost issues, the company ends up prioritizing the deliveries and valuing the functional aspects instead of usability concerns. In the vast majority of developed products there is concern about the quality of the final product and consequently with usability issues of the developed product, however the concern in delivering value to the customer in functional terms is much more valued due to cultural aspects of the company.

ANALYSIS POINTS	RESULTS
AP-09 - User interface design effort.	😐

The organization uses the concept of sprints of two weeks. For each sprint backlog prototypes are created often at the same time of software development. There is no use of the “Big Design Up Front” concept where most system screens are developed prior to software development. Designers are always trying to get ahead in a sprint, but the reality shows that the organization has a limited number of people working in this area, so this practice is not frequently executed.

ANALYSIS POINTS	RESULTS
AP-10 – Focus on usability tests.	😐

During the software development process there are functional tests, as well as integration tests and unit tests. Some usability tests with the participation of end users are also developed, but there are no metrics defined in the organization to perform such tests. The usability tests are very informal, where the main navigation difficulties of the users are detected, mainly in relation to the number of attempts made by the user to complete certain task or action within the system. It also checks the system response time and whether it is an end-user-acceptable response time.

ANALYSIS POINTS	RESULTS
AP-11 – Involvement of system users in the development process.	☺

As described in the previous analysis point some informal usability tests are performed directly with the end users. However, not only the tests are performed with the involvement of the final users, but also the requirements analysis. Typically, designers are allocated to work together with business analysts and product owners to understand the business along with system users. Low-fidelity prototypes are also often created for end-users perform some assessments and also to gain understanding of the business.

APPENDIX F – Organization B – Analysis Points description

ANALYSIS POINTS	RESULTS
AP-01 – Usability specialists in the composition of agile development teams.	😐

During the interviews it was possible to detect that the composition of agile teams is not built with multidisciplinary profiles, including designer, UI designers, UX designers or web developers. The organization has only one professional with knowledge in the area of design and usability that attend all projects of the organization as a shared resource. Because of this all the activities that involve the concern with the usability and user interface improvement of the legacy software has been abandoned. Currently this professional is only allocated to take care of the new demands with the innovation and prospecting team, as the cost of maintaining these professionals ends up being high.

ANALYSIS POINTS	RESULTS
AP-02 – Tools that help usability integration to software product development	☺

Today the designer of the company uses Adobe XD[9] as a tool to create navigable prototypes, mockups, and set screen patterns for the projects. As the company has only one professional allocated for this task, not all screens of the new solutions are prototyped.

The development teams use the IBM Jazz[10] as a tool to document the requirements of the project in form of user stories. To develop the design of the applications they use a specific framework based on Google's framework (Material Design[11]).

ANALYSIS POINTS	RESULTS
AP-03 – Focus of the integration of usability and agile software	☺

[9] https://www.adobe.com/br/products/xd.html
[10] https://jazz.net/
[11] https://material.io/design/

development for a specific type of development platform.	

The organization also develops software for different platforms, including web, mobile, desktop and a specific hardware (Raspberry). According to the interviewees there is an explicit dependence on the concern with usability and a specific platform. The company has invested heavily in research to address the front end of applications, going through various languages and frameworks like bootstrap[12] and angular[13] because it was difficult to meet usability requirements when development was targeted to mobile platforms. So, the organization adopted a customized framework based on Google's framework (Material Design) to attend both platform requirements. The applications started to be developed responsively using the concept of development called "mobile first". The interviewees also reported some concern about performance, response time, and the behavior of the system in different types of operating systems (iOS, Android).

ANALYSIS POINTS	**RESULTS**
AP-04 – Practices and/or processes that combine the user-centered design approach with the agile software development, demonstrating the integration of usability to agile software development.	☺

This is a large organization that focuses on the development of new products as well as the customization of a product, which is the organization's flagship product. This organization has been working with traditional development methodology for some years and also gets certified in MPS-BR (level G). Recently the managers decided to bet on agile software development and the organization has defined an agile development process based on Scrum. The organization has a main product (ERP- Enterprise Resource Planning) that focus on retail, mainly on supermarkets, materials for civil constructions and restaurants. Today more than four thousand customers are using this solution. Because of this main product they also started to develop embedded software to provide a cash front solution. This ERP is also used by the organization, so we can say that they develop software for your own use, as they have to adapt this solution for their own reality. They also attend different types of

[12] https://getbootstrap.com/
[13] https://angular.io/

demands and customers from different areas, developing custom solutions. Because of this type of demands they also implemented an innovation factory, that includes mobile solutions and studies of trends and projections. During the interviews was identified that practices like Kanban, grooming, daily meeting, retrospectives and all ceremonies of Scrum are carried out by the company. They use sprints of two weeks and to facilitate the communication between the product owner and the team user stories are used. For the communication with the client navigable prototypes are used.

ANALYSIS POINTS	RESULTS
AP-05 – Knowledge in the area of usability.	☹

During the interviews was possible to detect that the organization is lacking in knowledge in the area of usability. There is no initiative in the organization to promote usability in the area and also has no policy that encourages training in this area. The professionals involved in developing the solutions believe that training in this area would be useful for improving the final quality of the product, but the organization's culture does not work in favor of this point.

ANALYSIS POINTS	RESULTS
AP-06 – Top management support in the creation and implementation of policies that foster the integration between agile software development and usability.	☹

According to the interviewees there is no policy within the organization that fosters the integration of usability within agile development. Top management prefers to invest in development professionals than professionals related to the area of usability, whether web designers, UX designers or UI designers. The organizational culture of the company is still strongly linked to the functional outcome and not to the user experience. Developers sporadically come together to discuss random issues that are of common interest. It has been reported that sometimes design-related topics have already been discussed but with the aim of disseminating knowledge.

ANALYSIS POINTS	RESULTS
AP-07 – Organizational budget for investment in training of the technical staff for the integration of usability and agile software development.	☹

The organization does not have a specific budget for investment in knowledge in the area of usability in agile development. As mentioned earlier, there is no support from top management, nor is the company's culture prepared for it. Top management does not consider concerns about usability issues to be a priority at this time, and no policy that encourages such integration is being prospected.

ANALYSIS POINTS	RESULTS
AP-08 – Prioritization of usability issues during software development.	☹

It was identified that the company clearly prioritizes the delivery of functional software over usability. Respondents believe that the probable cause is that most managers have come from technical areas and are focused on results. The technical team ends up worrying more than the managers in delivering products with better aspects of usability than the managers themselves. Improvements have often been suggested in terms of usability, but the lack of time and resources end up making changes infeasible.

ANALYSIS POINTS	RESULTS
AP-09 – User interface design effort.	😐

In the process of software development defined by the organization the sprints are taking two weeks and during the beginning of the projects some navigable prototypes are developed. As the company has only one professional to develop these activities, the “Big Design Up Front” is not realized due to lack of resources. Once a standard for the project is established the prototypes are no longer created and thus the reduction of time in this phase of the project ends up being a side effect of the lack of resources.

ANALYSIS POINTS	RESULTS
AP-10 – Focus on usability tests.	☹

During the software development process, the development team execute different tests. In the vast majority of projects, the systems go through three types of tests. The first is the unit test, the second is a functional test performed by a developer who has not been responsible for the coding and finally some functional tests performed by the test team, which includes exploratory tests and automated tests. The team does not execute usability tests, since only functional requirements are focused during the analysis and development of the projects. The organization does not have defined metrics, even for the measurement or benchmark of functional requirements.

ANALYSIS POINTS	RESULTS
AP-11 – Involvement of system users in the development process.	😐

During the requirements analysis the designer produce some navigable prototypes that are usually validated in the second sprint by the product owners of the agile teams. During the interview it was found that this is one of the reasons for unnecessary spending of the company, since many of the requirements are implemented without being validated or requested by the end users. The end users are rarely involved in the development process. During the review ceremony the product owner is the person responsible to approve or not the features.

APPENDIX G – Organization C – Analysis Points description

ANALYSIS POINTS	RESULTS
AP-01 – Usability specialists in the composition of agile development teams.	😐

During the interviews it was possible to detect that the composition of agile team is not built with multidisciplinary profiles, including designer, UI designers, UX designers or web developers. The organization has recently created a new sector to include usability and UX concerns to software development process. Today they have only two professional working in this area that are attending all projects of the organization. Their responsibilities are related to develop corporative guidelines and create patterns for the visual identity issues (including fields, colors, fonts and rules) and integrate the developer to the whole creative process. The development team have specific skills that can deal with front-end and back-end development. So the UX team is working together with the development team to validate the corporative guidelines and also to create an UX culture.

ANALYSIS POINTS	RESULTS
AP-02 – Tools that help usability integration to software product development	☺

The UX team is using the Adobe XD[14] as a tool to create navigable prototypes, and mockups. Photoshop[15] and Illustrator[16] are also used for more punctual design.

ANALYSIS POINTS	RESULTS
AP-03 – Focus of the integration of usability and agile software development for a specific type of development platform.	☺

The organization develops software for different platforms, including web, desktop and mobile applications. According to the interviewees there is an explicit

[14] https://www.adobe.com/br/products/xd.html
[15] https://www.adobe.com/br/products/photoshop.html
[16] https://www.adobe.com/br/products/illustrator.html

dependence on the concerns related to usability and a specific platform. Mobile applications always require more tests and demand more time. The company has invested heavily in their professionals to incorporate UX and issues related to them. All systems developed are designed to run in mobile platforms, so the applications are designed to be responsive.

ANALYSIS POINTS	RESULTS
AP-04 – Practices and/or processes that combine the user-centered design approach with the agile software development, demonstrating the integration of usability to agile software development.	☺

This organization is focused on the development of software for their own products as well as the customization of an existent product or a new one. This organization has been working with agile practices but does not follow any specific process or framework. During the interviews was identified that practices like Kanban, simplified documentation, daily meeting, retrospectives are carried out by the company. Design thinking is another practice adopted by the UX team to contribute and improve the user experience of the developed products. Interviews with final users are usually made by both teams (UX and development).

ANALYSIS POINTS	RESULTS
AP-05 – Knowledge in the area of usability.	☺

During the interviews was possible to detect that the organization invested in knowledge and dedicated professionals to improve the area of usability and user experience. There are some initiatives in the organization to promote the knowledge on user experience and also encourage training in this area. In general, the developers recognize the importance of usability and improve the final user experience, but these topics were not their focus. Most of them are full stack developers and are used to work with front-end development. The UX team in order to disseminate knowledge also promotes lectures and workshops related to the area.

ANALYSIS POINTS	RESULTS
AP-06 – Top management support in the creation and implementation of policies that foster the integration between agile software development and usability.	☺

According to the interviewees the top management (including CEO and managers) is giving total support to the organization and are applying some policies that fosters the integration of usability within agile development. They are investing in professionals with specific skills that are able to transmit and also apply their knowledge inside their projects and teams. The organizational culture of the company is strongly concerned with the quality of their products and with the final user experiences. Workshops and trainings are constantly developed in the organization to foster the knowledge dissemination.

ANALYSIS POINTS	RESULTS
AP-07 – Organizational budget for investment in training of the technical staff for the integration of usability and agile software development.	☺

The organization does not have a specific budget for investment in knowledge in the area of usability or user experience in agile development. They have a specific budget for the whole operation, and it needs to be managed. The employees can suggest and request for specific training or to participate in congresses and workshops, but the managers will evaluate it.

ANALYSIS POINTS	RESULTS
AP-08 – Prioritization of usability issues during software development.	☺

The organization is concerned in deliver not just functional software but also usable software. Respondents believe that the whole company, including managers and CEO's, is engaged in produce software with quality. Because of this they are adapting their processes to include the new staff to work specifically with user experience. The focus of this area is on creating very consistent interfaces to ensure a quality in the products created.

ANALYSIS POINTS	RESULTS
AP-09 – User interface design effort.	☺

In the development process adopted by the organization sprints do not have pre-set time. Thus, a set of features are selected to be developed in a given sprint and therefore all related issues of user experience and usability of these specific demands are analyzed and developed through the use of application of Design Thinking[17] approach and the creation of navigable prototypes. All prototypes, after the creation of this specific staff, are being created based on the standards they set.

ANALYSIS POINTS	RESULTS
AP-10 – Focus on usability tests.	☹

The development teams are executing different types of tests, including integration, unit, stress and functional testes during the software development process. They have a specific group to apply these tests. The teams are not executing usability tests yet, since the concerns related to it are recent and a new culture for UX are being started by the organization. The organization does not have defined metrics yet, but initial pilot projects are being developed to apply the application of usability tests. They are also thinking and prospecting to use analytic tools to study the use of the screens, through quantitative values, and how they can improve the usability of the whole system.

ANALYSIS POINTS	RESULTS
AP-11 – Involvement of system users in the development process.	☺

In the current organization development process, the UX team is responsible for not only defining the guidelines and styles of the interfaces but also understanding the main difficulties and pains of the customers. Therefore, the users of the systems are

[17] As a reference we used (BROWN, 2008).

unavoidable in the initial process of analysis and are always being involved in the process.

APPENDIX H – Organization D – Analysis Points description

ANALYSIS POINTS	RESULTS
AP-01 – Usability specialists in the composition of agile development teams.	😐

During the interviews it was possible to detect that the composition of agile teams is not built with multidisciplinary profiles, including designer, UI designers, UX designers or web developers. The organization has only one professional with knowledge in the area of design and usability that attend all projects of the organization as a shared resource. All concerns related to usability and user experience are developed before the start of the development. The actual resource allocated to develop a product proposal mockup works hard to attend the user's expectation related to usability and user experience before the development starts. During the development phase the designer make just small adaptations and correction.

ANALYSIS POINTS	RESULTS
AP-02 – Tools that help usability integration to software product development	☺

Today the company does not have a pre-defined standardized tool to create mockups or navigable prototypes. The allocated resource responsible to develop the mockups or navigable prototypes has the freedom to choose the necessary tool. Usually the tools used by the professional are: Axure[18] and Sketch[19].

During the requirements analysis the designer also use some specific artifacts and techniques as journey maps, user interviews, guide styles and personas. They usually tried to map the critical path for the user navigation and improve the usability of the product to make this path less painful and more user friendly.

ANALYSIS POINTS	RESULTS
AP-03 – Focus of the integration of usability and agile software development for a specific type of development platform.	☺

[18] https://www.axure.com/
[19] https://www.sketchapp.com/

The organization develops software for their own use (internal use) using different platforms, including web, mobile, and a specific hardware (locomotive onboard computers). According to the interviewee there is an explicit dependence on the concern with usability and a specific platform, such as mobile platforms. All tests developed when the developed product is specific for mobile technologies are more detailed and usually demands more time.

ANALYSIS POINTS	RESULTS
AP-04 – Practices and/or processes that combine the user-centered design approach with the agile software development, demonstrating the integration of usability to agile software development.	😐

This organization is focused on develop their own solution for internal use, which includes embedded software, web applications and mobile development. Their solutions are focused on propose better solution in the logistic area.

This organization has been working with a specific agile development process based on Scrum, and in the last years has been adapted and shared in the company through wikis. The development teams use Confluence[20] as a tool to created and maintains them. But as the activities related to UX and usability are done before the development process start, so we cannot say that they are completely integrated.

But the organization adopted a practice of drawing flows during workshops developed with the final users before starting the development process. The first one is called “as is” and is used to map the activities as they are used to happen. This activity is focused on map the natural activities and difficult tasks developed by the users. The second one is called “to be” and is specific for drawing better solution based on the user’s feedback and experiences. Both are practices adopted by the designer that help to get closer user.

[20] https://br.atlassian.com/software/confluence

ANALYSIS POINTS	RESULTS
AP-05 – Knowledge in the area of usability.	☹

During the interviews was possible to detect that the organization is immature and is starting to prioritize the user experience and get knowledge in the area of usability. Despite of following known software development process the organization needs to organize itself and prioritize issues regarding to knowledge management in general. Often the knowledge gained during a project is lost due to lack of structuring and organization of documents. The initiative of the organization to promote usability exists and they recognize the importance, but there is still a long way to go since only one professional is allocated to perform this activity.

ANALYSIS POINTS	RESULTS
AP-06 – Top management support in the creation and implementation of policies that foster the integration between agile software development and usability.	☹

According to the interviewee there is no policy within the organization that fosters the integration of usability within agile development. Some managers understand the importance of usability and user experience in software development process but are unwilling to invest more resources in this area. Most part of top managers are engineers and are more interested in control budgets. At this moment investment on improve and give support to this area are not priority.

ANALYSIS POINTS	RESULTS
AP-07 – Organizational budget for investment in training of the technical staff for the integration of usability and agile software development.	☹

The organization does not have a specific budget for investment in knowledge in the area of usability or user experience. Employees can recommend a specific training, independent of the area, to the manager but they have to wait for manager analysis. They are not always accepted. Investments on bringing new developers are made because it brings visible returns to the projects. According to the interviewee the

culture UX is not very well understood and because of this they do not have much investment.

ANALYSIS POINTS	RESULTS
AP-08 – Prioritization of the usability issues during software development.	😐

Despite of not having much investment on usability and UX the organization does not prioritize the delivery of functional software over usability all the time. Otherwise, they always tried to prototype and make workshops with end users to specify the requirements. Sometimes they do not have enough time to apply usability tests, or they do not have enough resources to make specific UX tasks. But the prioritization of deliver functional software over usable software is not a reality in this organization.

ANALYSIS POINTS	RESULTS
AP-09 – User interface design effort.	☺

In the process of software development defined by the organization the designer develops a “Big Design Up Front” before the software development start. So, he is responsible for delivering a navigable prototype or a simplified version like a mockup to the development team. This is only possible because the company does not develop software for the market, but for their own, so their demands are reduced.
Once the prototypes are approved by the final users and also by the clients it is delivered to the development team. The designer is involved just to correct small mistakes or to make few modifications.

ANALYSIS POINTS	RESULTS
AP-10 – Focus on usability tests.	😐

During the software development process, the development team does not execute usability tests because they are not prepared and do not have the knowledge required to develop them. The designer is responsible to develop heuristics analysis,

and cognitive tests. The organization does not have defined metrics, even for the measurement or benchmark.

ANALYSIS POINTS	RESULTS
AP-11 – Involvement of system users in the development process.	☺

According to the interviewee the end users are always involved not just in the initial phase of the project, where the journey maps and the flows (“as is” and “to be”) are done but also during the requirement analysis and development phase when some usability tests are developed.

APPENDIX I – Organization E – Analysis Points description

ANALYSIS POINTS	RESULTS
AP-01 – Usability specialists in the composition of agile development teams.	😐

During the interviews it was possible to detect that the organization have two separated departments: one for development and other for design. The design department is responsible to start the requirements analysis with the costumers and final users, produce wireframes and navigable prototypes. Actually, five resources are available to provide this kind of service for the whole organization. Typically, the development teams are multidisciplinary which includes the participation, but not for full time, of a designer. So, the vast majority of usability and user experience concerns are solved or improved by the design team before implementation starts. The organization calls this phase of the project as “Discovery”. The participation of the designers in the development teams during the software development therefore ends up being very punctual.

ANALYSIS POINTS	RESULTS
AP-02 – Tools that help usability integration to software product development	☺

The organization uses one specific tool to create mockups, wireframes and navigable prototypes called Adobe XD[21]. During the requirements analysis phase, called “Discovery”, the designer also use some specific artifacts and techniques as journey maps, user interviews, and personas. They usually tried to map the critical path for the user navigation and improve the usability of the product to make this path less painful and more user friendly.

ANALYSIS POINTS	RESULTS
AP-03 – Focus of the integration of usability and agile software development for a specific type of development platform.	☺

[21] https://www.adobe.com/br/products/xd.html

The organization develops software for their own use (internal use) using different platforms, including web, mobile and also develop custom software. According to the interviewee there is an explicit dependence on the concern with usability and a specific platform, such as mobile platforms. All tests developed when the developed product is specific for mobile technologies are more detailed and usually demands more time.

ANALYSIS POINTS	RESULTS
AP-04 – Practices and/or processes that combine the user-centered design approach with the agile software development, demonstrating the integration of usability to agile software development.	😐

This organization develops its own solutions for internal use and also custom software. There is no specific area that the organization is used to develop custom software, but some areas like education, bank and health are more common. The organization chose to work with Design Thinking approach combined with Kanban during the Discovery phase. Some techniques and artifacts like personas and user journey maps are being used by the design team to make the initial requirements analysis. The organization also defined Scrum as the agile software development process. Despite of having tools that enable the integration of agile development and user-centered design we cannot say that they are completely integrated because the activities related to UX and usability are done before the development process start.

ANALYSIS POINTS	RESULTS
AP-05 – Knowledge in the area of usability.	☺

During the interviews was possible to detect that the organization has invested in the last years in the area of usability and user experience. For this reason, there is a specific department to meet the demands of these areas. The resources of this area are also allocated into agile development projects and thus intend to disseminate the knowledge in the area. In addition, there are some specific tools that are used by the organization that foster collaboration and communication between teams such as

Facebook Workplaces[22]. In this way groups of studies and communities are been created in this tool to make possible the availability of material for studies and the dissemination of knowledge.

ANALYSIS POINTS	RESULTS
AP-06 – Top management support in the creation and implementation of policies that foster the integration between agile software development and usability.	☺

According to the interviewee, the top management recognize the importance of understand the final user expectations and their experiences. Because of this they foster the integration of usability within agile development. They give support for new ideas and promote practices to improve the quality of the final product.

ANALYSIS POINTS	RESULTS
AP-07 – Organizational budget for investment in training of the technical staff for the integration of usability and agile software development.	😐

The organization does not have a specific budget for investment in knowledge in the area of usability or user experience. The trainings end up being more frequent in the area of software development and very few in the area of design and user experience. But the employees can recommend a specific training, independent of the area, to the manager but they have to wait for manager analysis.

ANALYSIS POINTS	RESULTS
AP-08 – Prioritization of the usability issues during software development.	😐

According to the interviewee in some cases the organization prioritizes the delivery of functional software over usable software. Criteria related to the client's deadlines and tight budgets are forcing the development of lean solutions and without so much study or usability testing with users.

[22] https://pt-br.facebook.com/workplace

ANALYSIS POINTS	RESULTS
AP-09 – User interface design effort.	☺

As previously described, the organization has two distinct departments, one for design and one for development, which work collaboratively on the same demand. In this way the design team through its "Discovery" process maps the main requirements of the users and proposes solutions to its customers in the form of navigable prototypes. Therefore, although this activity is not being developed during a Sprint and by the multidisciplinary team, the effort for the design of the interfaces exists.

ANALYSIS POINTS	RESULTS
AP-10 – Focus on usability tests.	☹

During the analysis of this organization was possible to detect that no usability test was being executed by developer or by Ux designers. In some projects they started to use specific tools like Google Analytics[23] or Optimize[24] to track which pages are being accessed and which are not and why.

ANALYSIS POINTS	RESULTS
AP-11 – Involvement of system users in the development process.	☺

According to the interviewee the end users are always involved in the initial phase of the project, called Discovery, where the requirements analysis is done and some artifacts are developed to map the user's difficulties like user journey maps and personas. In Ideation phase the clients and final users are involved and at the end of a sprint, where the tests take places the users are always involved.

[23] https://analytics.google.com/analytics/
[24] https://optimize.google.com/optimize/home/

APPENDIX J – Organization F – Analysis Points description

ANALYSIS POINTS	RESULTS
AP-01 – Usability specialists in the composition of agile development teams.	😐

During the interviews it was possible to detect that the organization is working with multidisciplinary teams that include designers, testers, developers and engineers to work with embedded software. Today the organization has only three designers available to work with the development teams.

AP-02 – Tools that help usability integration to software product development	☺

The organization uses one specific tool to create mockups, wireframes and navigable prototypes called Adobe XD[25]. To create some specific flowcharts, process diagrams and UML diagrams they are using a specific toll called Draw[26]. The development team is using another tool called Taiga[27] to integrate the team as well as the project documentation.

ANALYSIS POINTS	RESULTS
AP-03 – Focus of the integration of usability and agile software development for a specific type of development platform.	☹

The organization develops software for different platforms, including web, mobile and also embedded software. According to the interviewee there is no explicit dependence on the concern with usability and a specific platform, such as mobile platforms. All requirements and tests are developed in the same form independent platform. According to them usability and user experience issues are important and relevant for every platform.

[25] https://www.adobe.com/br/products/xd.html
[26] https://www.draw.io
[27] https://taiga.io/

ANALYSIS POINTS	RESULTS
AP-04 – Practices and/or processes that combine the user-centered design approach with the agile software development, demonstrating the integration of usability to agile software development.	☺

This organization develops its own solutions for internal use and also custom and embedded software. Despite of being for more than 10 years in the market the organization is considered a startup, because at the beginning they were in a seed stage. Some companies recently made investments in the organization to increase the business. They develop specific solutions for the health area. The Organization is using a process for software development based on Scrum and the sprints usually takes less than one week (three or four days). Developers are using user stories to document the requirements as well as use cases. They are also using Kanban to manage the activities and to integrate de development team. Designers are also working with Design Thinking approach and are using its phases (empathy, ideation, prototyping and tests) to make the requirement analysis. Designers are also using a specific artifact called “Guide Styles” to pre-define some design patterns for interface creation. They are usually defined for each project. Journey maps and blueprints are usually used by designers to define the initial requirements and pain points. According to the interviewee all artifacts (including the design ones) are developed during the software development process along with the developers.

ANALYSIS POINTS	RESULTS
AP-05 – Knowledge in the area of usability.	☺

During the interviews was possible to detect that the organization has invested in the last years in the area of usability and user experience. Today the organization has three designers available to work with the development teams. In all projects that are being developed in the organization, they have at least one designer participating on it. So, the knowledge related to usability or UX is being disseminated in the organization.

ANALYSIS POINTS	RESULTS
AP-06 – Top management support in the creation and implementation of policies that foster the integration between agile software development and usability.	☺

According to the interviewee, the top management gives total support on the integration of usability and UX issues and agile software development. They recognize the importance and the impact of a good product design in the market. They are always open for new suggestion and practices to improve the quality of the product.

ANALYSIS POINTS	RESULTS
AP-07 – Organizational budget for investment in training of the technical staff for the integration of usability and agile software development.	😐

The organization does not have a specific budget for investment in knowledge in the area of usability or user experience. They have an organizational budget to spend in trainings, participation in conferences, lectures and workshops in general. The organization also offers financial support to those employees who wish to undertake a postgraduate or improvements in their area of activity in the organization.

ANALYSIS POINTS	RESULTS
AP-08 – Prioritization of usability issues during software development.	☺

According to the interviewee the organization did not prioritizes the delivery of functional software over usability and work hard to develop products with an acceptable level of over usability. The organization is concerned with usability issues and the development team is always trying to develop the minimum viable product being sure that it is a usable product.

ANALYSIS POINTS	RESULTS
AP-09 – User interface design effort.	☺

During the analysis of the organization was possible to detect that they do not use the concept of a “Big Design Upfront”. They frequently work with the concept of

many “Little Design Upfront” during the MVP development. Therefore, the creation of prototypes ends up happening in the same sprint of the development.

ANALYSIS POINTS	RESULTS
AP-10 – Focus on usability tests.	☺

According to the interviewee the usability and user experience tests are designer responsibilities and are made for each deploy. Heuristic tests are made over the interfaces and constant improvements are being applied to products after the costumer’s tests.

ANALYSIS POINTS	RESULTS
AP-11 – Involvement of system users in the development process.	☺

According to the interviewee the end users are always involved in the initial phase of the project, where all critical points of the process are mapped through the journey maps, and at the end of development these critical points are used as starting points for usability tests. The participation of end-users is essential in the organization's development process since all improvements are raised through the MVP's presented to them.

APPENDIX K – Organization G – Analysis Points description

ANALYSIS POINTS	RESULTS
AP-01 – Usability specialists in the composition of agile development teams.	😐

In this organization it was possible to detect that the composition of agile team is not always built with multidisciplinary profiles, including designer, UI designers, UX designers or web developers. A specialist outside the organization is frequently hired to work on specific projects that requires more elaborated skills to develop the user interfaces. Sometimes the clients ask for more usable interfaces and then a partnership is established with an external company to produce its specific contents or when a completely new projects is started then the designer is involved since the beginning of the project.

AP-02 – Tools that help usability integration to software product development	☺

The organization is working to establish a defined software development process and because of this they are using and testing some different tools to help the first phases as software analysis. To make the preliminary notes the interviewer said that usually uses a web-based diagram tool called Cacoo[28]. This tool helps the team integration as all diagrams are available in cloud and the team can use an internal chat to communicate and work in a remote mode. Some mockups are also developed in this platform and to produce the layout as a complement they use Adobe Photoshop[29].

ANALYSIS POINTS	RESULTS
AP-03 – Focus of the integration of usability and agile software development for a specific type of development platform.	☺

The organization develops software for their own use (internal use) and custom software using different platforms, including desktop, web and mobile. According to the

[28] https://cacoo.com
[29] https://www.adobe.com/br/products/photoshop.html

interviewee there is an explicit dependence on the concern with usability and a specific platform, such as mobile platforms. The usability concerns related to mobile applications are usually more evident and require more effort for their creation and consequently require more tests and demand more time.

ANALYSIS POINTS	RESULTS
AP-04 – Practices and/or processes that combine the user-centered design approach with the agile software development, demonstrating the integration of usability to agile software development.	☺

This organization develops custom software, software for their own use which includes web applications and mobile development. Their solutions are not focused on a specific area, so their demand comes from different areas. This organization has been working with a specific agile development process based on Scrum. The development teams use Jira[30] as a tool to create the software documentation.

The development team creates the vision document as an initial input and also create user stories to compose their backlog. Workflows are also used to complement the documentation. The organization did not use specific artifacts like users' journeys maps or personas to map the user expectations or experiences.

The development team is concern with usability issues and because of this the organization uses frameworks like Bootstrap[31], Ionic[32] and Angular[33] to develop responsive, light, cross platform and fast products and also invest on bringing new libraries like React[34] to build user interfaces.

The organization also works with a goal management framework called OKR (Objectives and Key Results) that help companies to implement strategies, which improve the focus, transparency, and better alignment.

ANALYSIS POINTS	RESULTS
AP-05 – Knowledge in the area of usability.	😐

[30] https://br.atlassian.com/software/jira
[31] https://getbootstrap.com/
[32] https://ionicframework.com/
[33] https://angular.io/
[34] https://reactjs.org/

During the interviews was possible to detect that the knowledge in the area of usability and user experience inside the organization is very restricted. Few members of the development team have knowledge or is interested in study this area. We could observe that this movement happens probably because the organization's culture is focused on bring a specific talent inside the organization to develop a specific task or work. In some cases when the project takes more time, this hired talent disseminates the knowledge, but it happens naturally.

The organization started a movement to organize their development process and want to invest more on user experience and usability. They intend to bring and hire specific skills to work in this area and maintain them in the development team.

ANALYSIS POINTS	RESULTS
AP-06 – Top management support in the creation and implementation of policies that foster the integration between agile software development and usability.	☺

According to the interviewee, the top management understands and recognizes the importance of integrates usability and agile software development and they are trying to implement policies to foster it.

When the client asks for a better user experience or for a rich design the company provide it hiring an external professional. The idea is to develop an increase this area inside the organization, but the organization needs to be financially prepared for it. They know that this model of work is not ideal, but it meets the customer's need.

ANALYSIS POINTS	RESULTS
AP-07 – Organizational budget for investment in training of the technical staff for the integration of usability and agile software development.	☺

The organization does not have a specific budget for investment in knowledge in the area of usability or user experience. They have an organizational budget to spend in trainings, participation in conferences, lectures and workshops in general. The organization also offers financial support (30%of the total amount) to those employees who wish to undertake a postgraduate or improvements in their area of activity in the organization.

ANALYSIS POINTS	RESULTS
AP-08 – Prioritization of usability issues during software development.	☹

According to the interviewee the organization usually prioritizes the delivery of functional software over usability. The organization focus is to deliver value on time to client and issues related to usability are frequently developed, as the product is getting mature.

ANALYSIS POINTS	RESULTS
AP-09 – User interface design effort.	☺

During the analysis of the organization was possible to detect that they do not use the concept of a “Big Design Upfront”. They frequently work with the concept of sprints and focus on deliver the features selected. According to the interviewee it would be impractical to do a “Big Design Upfront” for reasons related to cost and time. But in some sprints the external designer works temporarily to develop usable interfaces. When the organization is the initial phase of the contract (analyzing the demand and getting their costs) an initial design of the product is developed but in a very high level.

ANALYSIS POINTS	RESULTS
AP-10 – Focus on usability tests.	😐

According to the interviewees the organization focus is on functional tests and not on usability and user experience tests. Every development phase has a specific price, and it appears on the client contract. So, if the client asks for it and the product demand more specific usability tests, the client pays for it. Usability tests are not included in their development process. They usually use a tool (Selenium[35]) to automates and reproduce the functional tests.

[35] https://www.seleniumhq.org/

Related to usability tests the organization created a checklist, based on Nielsen heuristics, to validate usability issues. They combine it with OKR to establish objectives and specific results as a “definition of done”.

ANALYSIS POINTS	RESULTS
AP-11 – Involvement of system users in the development process.	😐

According to the interviewee the end users are not always involved in all phases of the software development. The organization defined that at least the homologation of the projects needs the presence of a system user. This practice sometimes results in rework because the users are not involved in the analysis phase. The communication can fail even with customers, which also can result in rework.

APPENDIX L – PROTOCOL FOR DEVELOPMENT- COVER LETTER

Curitiba, <DIA> de <MÊS> de <ANO>.

À <ORGANIZAÇÃO>

Prezada Senhora,

Venho, através desta, solicitar a sua autorização para a condução de um experimento da tese de doutorado da aluna **Karina Paula de Camargo Curcio**, que está sendo desenvolvida sob minha orientação com co-orientação da professora Sheila Reinehr no Programa de Pós-Graduação em Informática da PUCPR, cujo título é: “An Approach For User Experience Design Integration into Agile Software Development”.

O objetivo principal da pesquisa é aplicar a abordagem criada durante o desenvolvimento da tese, intitulada “UXIAD – User eXperience Design Integration for Agile Development”, e coletar os resultados desta aplicação junto aos envolvidos no projeto.
Sugerimos para este experimento o uso do projeto para a Impressão das Carteiras Funcionais da Polícia Civil do Estado.
Para a avaliação final da abordagem utilizaremos dois questionários. O primeiro visa coletar informações sobre a experiência final dos usuários com relação ao novo módulo ou produto desenvolvido. Caso esta nova solução venha substituir uma já existente, também avaliaremos a percepção dos usuários em relação a solução atual por meio deste mesmo questionário.
Já o segundo questionário visa coletar informações sobre a facilidade de uso da abordagem e terá como público alvo o time envolvido no desenvolvimento da solução.

Gostaria, ainda, de afirmar o nosso compromisso em relação à confidencialidade das informações prestadas. Todos os dados serão tratados de forma a preservar a privacidade, tanto dos envolvidos, quanto da instituição. Nenhuma informação personalizada será publicada, a menos que autorizado formalmente pela empresa. Um Termo de Confidencialidade será assinado pelas pesquisadoras, com termos a critério da empresa.

Aguardamos o seu retorno e antecipadamente agradecemos pela colaboração.

Atenciosamente,

Andreia Malucelli, PHD
Programa de Pós-Graduação em Informática - PPGIa
Pontifícia Universidade Católica do Paraná

APPENDIX M – PROTOCOL FOR DEVELOPMENT - NON-DISCLOSURE TERMS

TERMO DE CONFIDENCIALIDADE

Este Termo de Confidencialidade visa estabelecer um acordo entre as pesquisadoras Karina Paula de Camargo Curcio, Andreia Malucelli e Sheila Reinehr, doravante denominados Pesquisadores, e <NOME DA ORGANIZAÇÃO> doravante denominada Empresa Participante, a respeito da confidencialidade das informações coletadas durante o processo de pesquisa da tese de doutorado da primeira, intitulado: “An Approach For User Experience Design Integration Into Agile Software Development”**.**

Por meio deste Termo de Confidencialidade, os Pesquisadores se comprometem a:

- Portar-se com discrição em todos os momentos da pesquisa acadêmica, não comentando ou divulgando qualquer tipo de informação que tenha sido repassada de forma oral ou escrita.
- Não divulgar o nome da Empresa Participante, em qualquer meio, a menos que expressamente autorizado por esta.
- Não divulgar, em qualquer meio, os dados e informações individualizados coletados durante o processo de pesquisa na Empresa Participante.
- Divulgar, em formato de tese, artigos e apresentações, apenas os dados agregados, dos quais não se possa retirar ou inferir a identificação da Empresa Participante.
- Retornar para a Empresa Participante as informações coletadas e analisadas, em formato individualizado dos seus próprios dados.

As assinaturas abaixo expressam a concordância quanto ao cumprimento deste Termo de Confidencialidade, por prazo indeterminado.

Curitiba, <DIA> de <MÊS> de <ANO>.

_____ _____

Karina Curcio Andreia Malucelli

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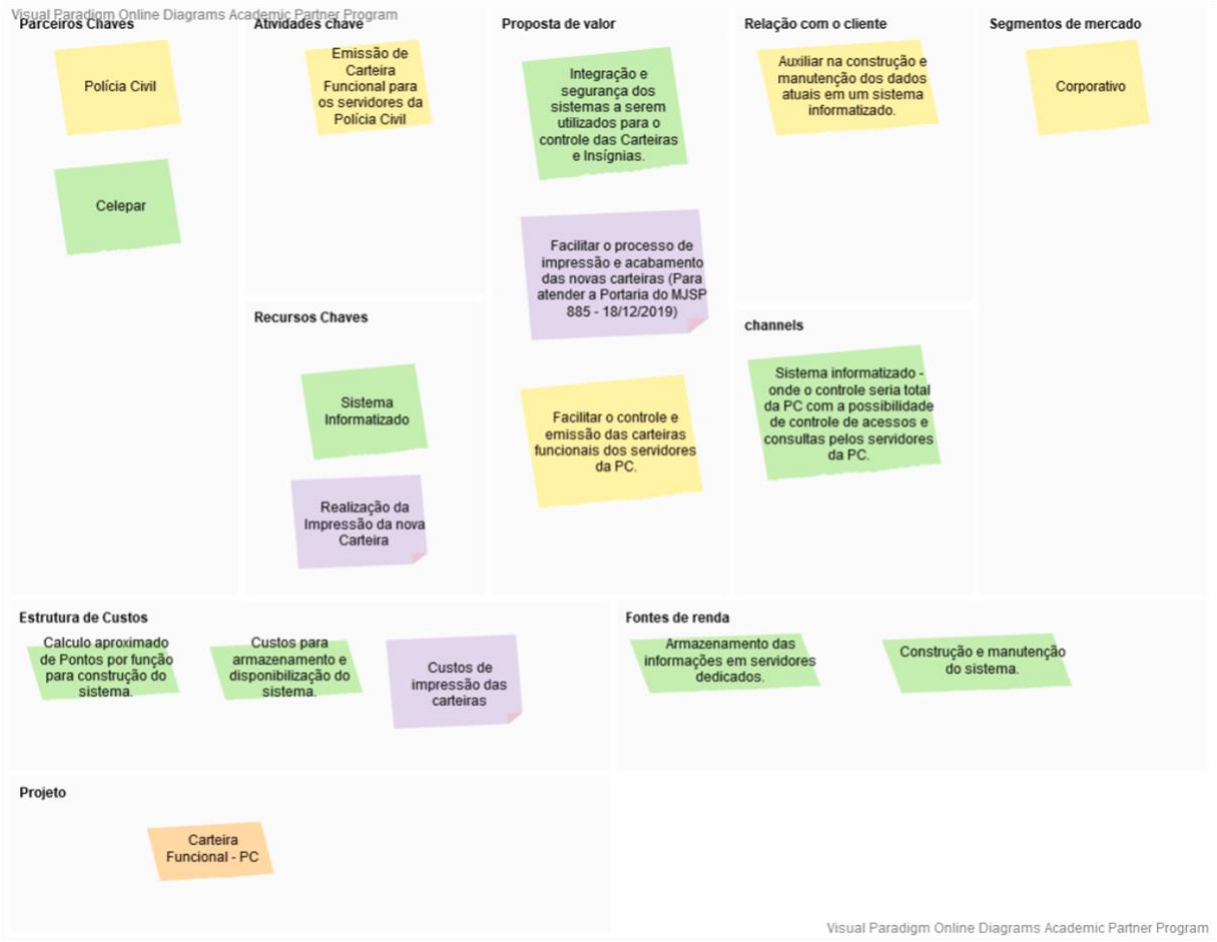
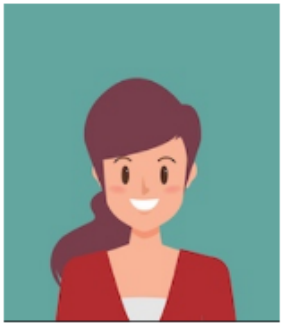
Sheila Reinehr

APPENDIX N – ARTIFACTS DEVELOPED – BUSINESS MODEL CANVAS



APPENDIX O – ARTIFACTS DEVELOPED – PERSONAS

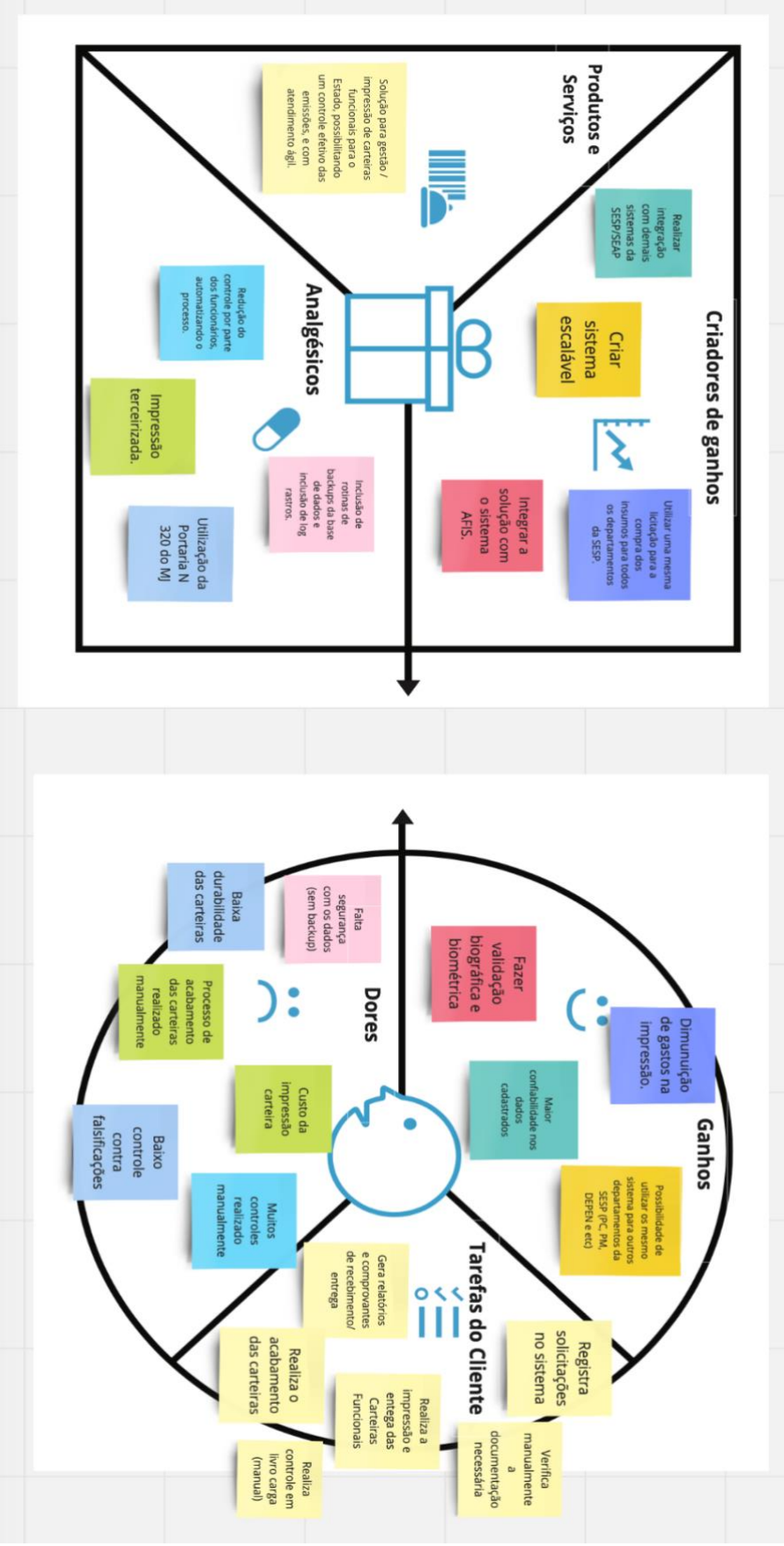
1. SYSTEM USER

PERSONA	Cliente (Órgão): Polícia Civil Projeto: Carteira Funcional Date: 11/05/2020 Responsável: Celepar
	**Dados Pessoais** Nome: Francielle Idade: 36 | Gênero: Feminino Estado Civil: casada Natural de: Brasileiro(a) Formação: Superior Ocupação Atual: Papiloscopista
1) Breve Biografia: Francielle possui curso superior em direito e participou de cursos específicos de formação da Escola da Polícia Civil. Exerce sua carreira como policial civil e atualmente está alocada no setor responsável pelas emissões e gestão de carteiras funcionais dos policiais civis.	2) Objetivos: Tem como objetivo melhorar a gestão e as rotinas hoje empregadas no setor para o controle, emissão e distribuição, tanto das carteiras funcionais quanto das insígnias e os porta documentos (conjunto documental), que são entregues aos policiais logo após a admissão dos mesmos na corporação,
3) Necessidades: - Necessita de uma solução que possa substituir o sistema atual de controle de impressão de carteiras funcionais. -Melhorar a logística de confecção das carteiras funcionais; - Melhorar a segurança dos dados; - Facilitar o controle de distribuição das insígnias; - Possibilidade de desburocratizar o processo de como é realizado atualmente; -Interligação com outros sistemas da Polícia Civil e da SESP.	4) Problemas encontrados: - Sistema atual não é integrado a outras soluções da Polícia Civil. -Sistema atual não possui um módulo específico para controle de insígnias e porta documentos de forma automatizada. - Sistema atual não emite os documentos segundo a nova Portaria (do Ministério da Justiça); - O sistema atual atende apenas a PC e a SESP necessita de uma solução que atenda outros órgão (PM, DEPEN, Policia Científica); - Processo de criação, montagem e distribuição das carteiras ainda muito manual;
5) Motivações – Como podemos ajudar? Desenvolver um novo sistema, em substituição do sistema antigo, para controlar a emissão das carteiras funcionais, insígnias e porta documentos, viabilizando a automação de diversas rotinas e realizando a integração com demais sistemas da SESP.	

1. EMPLOYEE

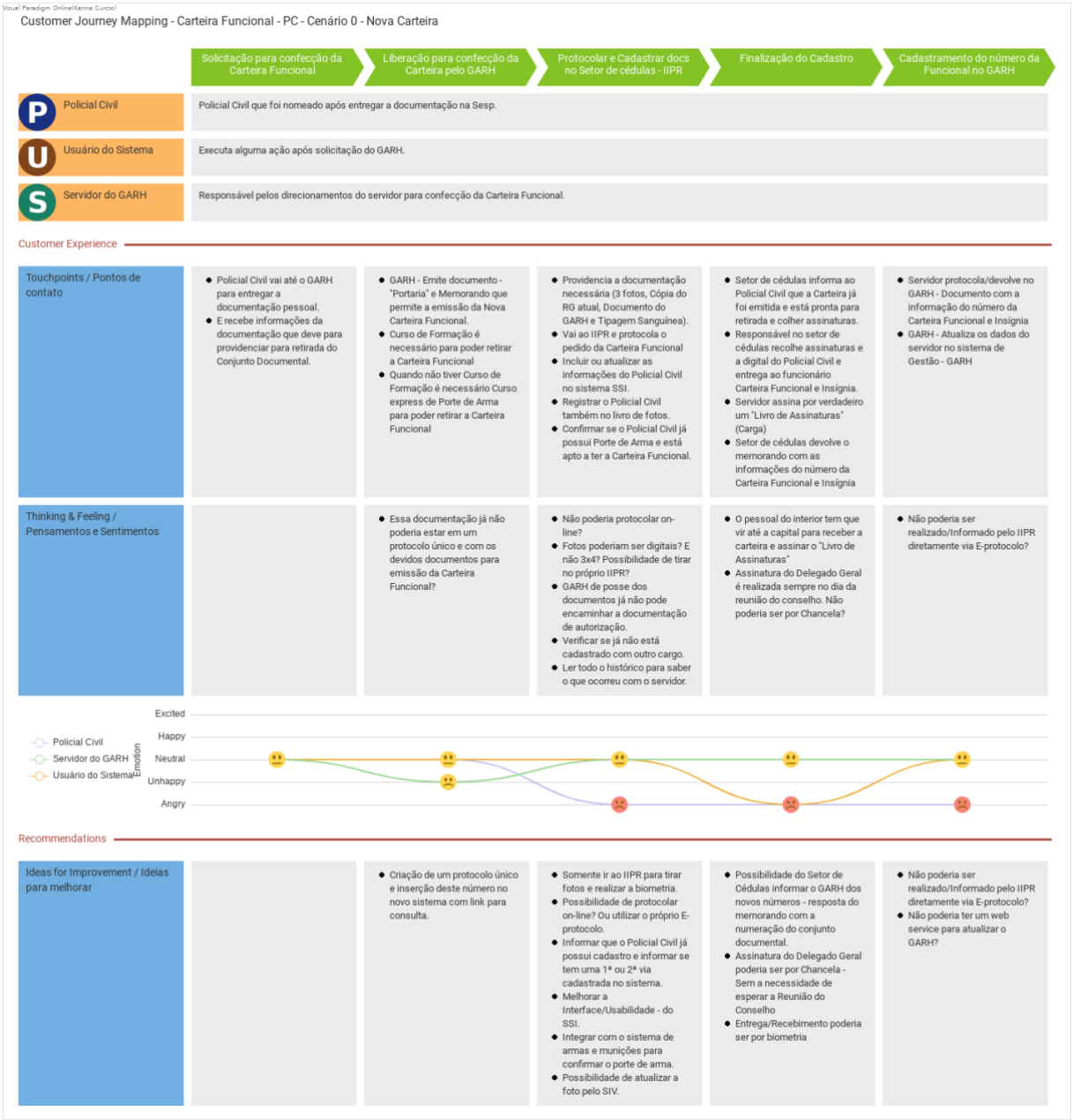
PERSONA	Cliente (Órgão): Polícia Civil Projeto: Carteira Funcional Date: 11/05/2020 Responsável: Celepar
	**Dados Pessoais** Nome: Clayton Idade: 43 | Gênero: Masculino Estado Civil: solteiro Natural de: Brasileiro(a) Formação: Superior Ocupação Atual: Policial Civil
1) Breve Biografia: Clayton é um policial civil (papiloscopista) e atualmente está alocado no Instituto de Identificação do Estado do Paraná. Participou de cursos de formação específicos da Escola da Polícia para poder exercer suas atividades e hoje atua em uma subdivisão técnica subordinada à Direção do Instituto.	2) Objetivos: Como hoje ele atua como coordenador em uma unidade funcional (subdivisão técnica), tem por objetivo melhorar os processos de gestão de maneira geral do Instituto. Isto inclui os processos que envolvem a emissão das carteiras funcionais.
3) Necessidades: -Necessita que o IIPR providencie uma solução moderna e segura para a obtenção/impressão não só da sua carteira funcional, mas como também de qualquer servidor (ativo ou inativo) da PC. -A solução deverá desburocratizar o processo, sem ter a necessidade de levar presencialmente seus documentos pessoais, como acontece atualmente. -Possibilitar a reimpressão destes documentos, quando danificados, furtados ou roubados. -Possibilitar a gestão das carteiras em demais situações (exoneração, retenção e devoluções).	4) Problemas encontrados: - Processo para obtenção da carteira funcional é moroso. -Necessidade de obtenção da assinatura do delegado geral (chancela) manualmente; -Necessidade de levar documentos para comprovar sua identidade e foto para ser colada no documento; - Policiais alocados no interior tem dificuldade para a obtenção dos documentos;
5) Motivações – Como podemos ajudar? Desenvolver um sistema capaz de integrar as soluções da Sesp, viabilizando a impressão das carteiras funcionais de forma mais rápida, carregando dados biográficos e biométricos de forma automatizada e agilizando o processo como um todo.	

APPENDIX P – ARTIFACTS DEVELOPED – VALUE PROPOSITION CANVAS



APPENDIX Q – ARTIFACTS DEVELOPED – USER JOURNEY MAPS

1. USER JOURNEY MAP – NEW FUNCTIONAL IDENTIFICATION



2. USER JOURNEY MAP – NEW FUNCTIONAL IDENTIFICATION FOR RETIREES

3. USER JOURNEY MAP – (SEGUNDA VIA)

4. USER JOURNEY MAP - REPRINT

5. USER JOURNEY MAP - LICENSES

6. USER JOURNEY MAP - DEVOLUTION

7. USER JOURNEY MAP - REINSTATEMENT

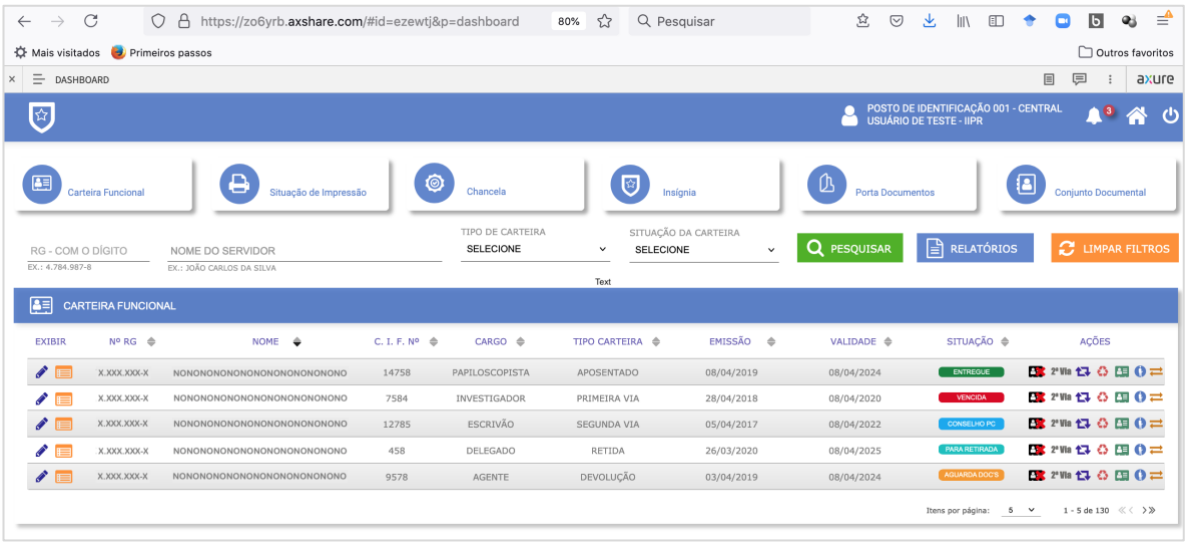
APPENDIX R – ARTIFACTS DEVELOPED – INITIAL BACKLOG

Itens de Trabalho Incluir Item ☐ Somente itens sem Pontos ☑ Itens resolvidos (também) ☑ Itens fechados (também) ☐ Somente Itens sem Sprint ☐ Somente Itens do Projeto atual ☐ Mostrar Projeto alvo

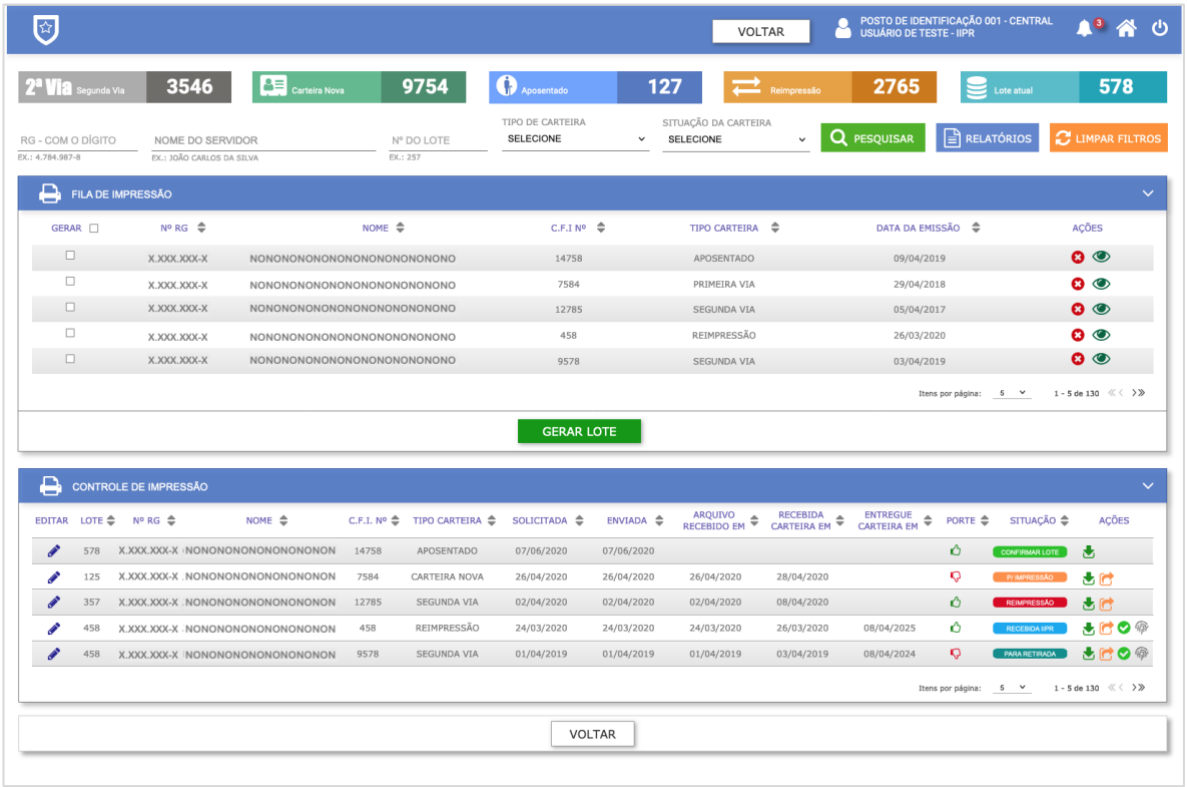
Ordem de Classificação	Valor de Negócio	Pontos	ID	Resumo	Sprint
			38437	Migrar Dados Carteira Funcional - Policia Militar	
			38438	Migrar Dados Servidores da Carteira Funcional - Policia Militar	
			38439	Migrar Dados Históricos da Carteira Funcional - Policia Militar	
			38440	Migrar Dados Carteira Funcional - Policia Científica	
			38441	Migrar Dados Servidores da Carteira Funcional - Policia Científica	
			38442	Migrar Dados Históricos da Carteira Funcional - Policia Científica	
			38443	Migrar Dados Insignias - Policia Científica	
			38444	Migrar Dados Carteira Funcional - DEPEN	
			38445	Migrar Dados Servidores da Carteira Funcional - DEPEN	
			38446	Migrar Dados Históricos da Carteira Funcional - DEPEN	
			38547	Web Service Obter Porte de Arma - SCAM	
			41910	Entrega da Carteira por Biometria	
			45698	Preparação do teste de usabilidade - Conjunto Documental	
3		3	38385	Web Service Obter Pessoa - SIV	Sprint 1 - Identificação do órgão e Manter Chancela
5		16	38403	Manter Chancela	Sprint 1 - Identificação do órgão e Manter Chancela
4		3	38414	Web Service Obter Imagens - AFIS	Sprint 1 - Identificação do órgão e Manter Chancela
1		3	38415	Web Service Obter Validação de acesso - SESP SEGURANÇA	Sprint 1 - Identificação do órgão e Manter Chancela
2		14.50	38430	Identificar Cliente	Sprint 1 - Identificação do órgão e Manter Chancela
6		27	38650	Ambiente de Homologação	Sprint 1 - Identificação do órgão e Manter Chancela
7		72	38707	Levantamento para migração - Policia Civil IIPR	Sprint 1 - Identificação do órgão e Manter Chancela

APPENDIX S – ARTIFACTS DEVELOPED – PROTOTYPES

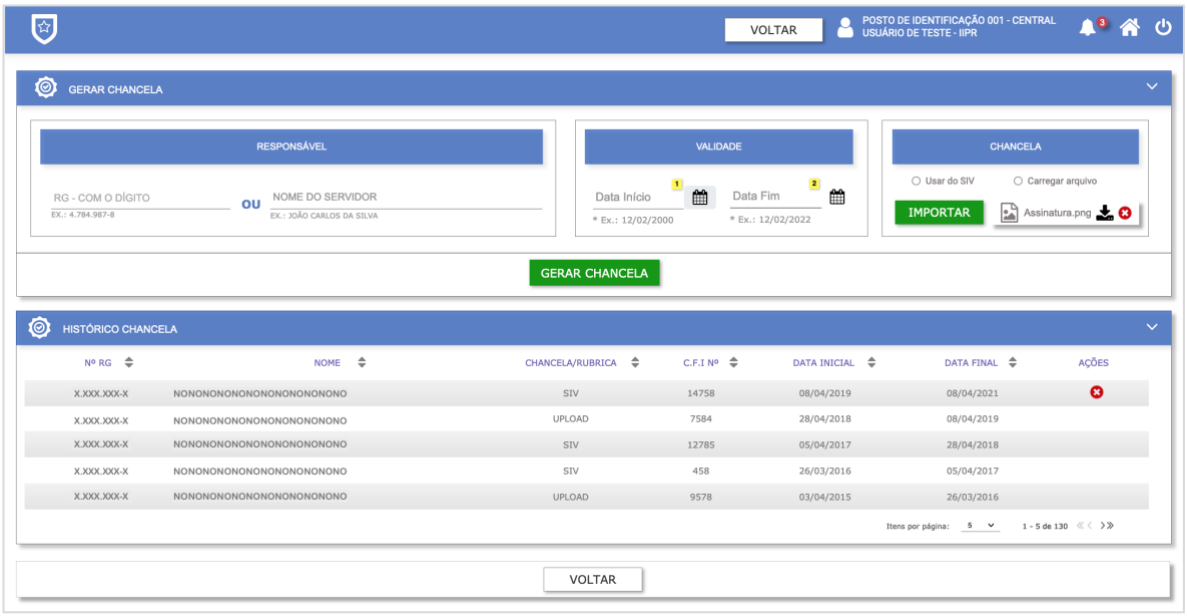
1. HOME SCREEN



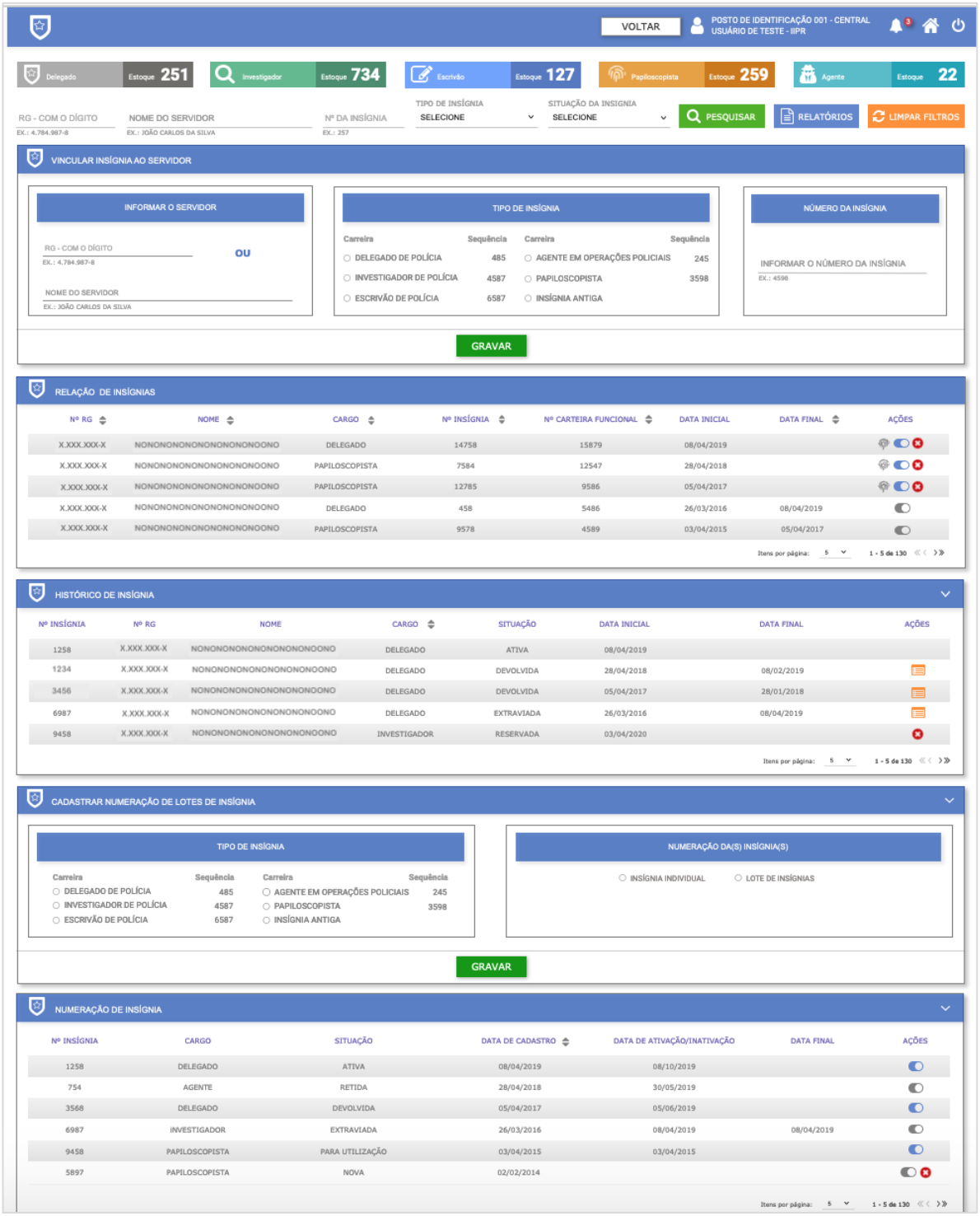
2. PRINTING STATUS



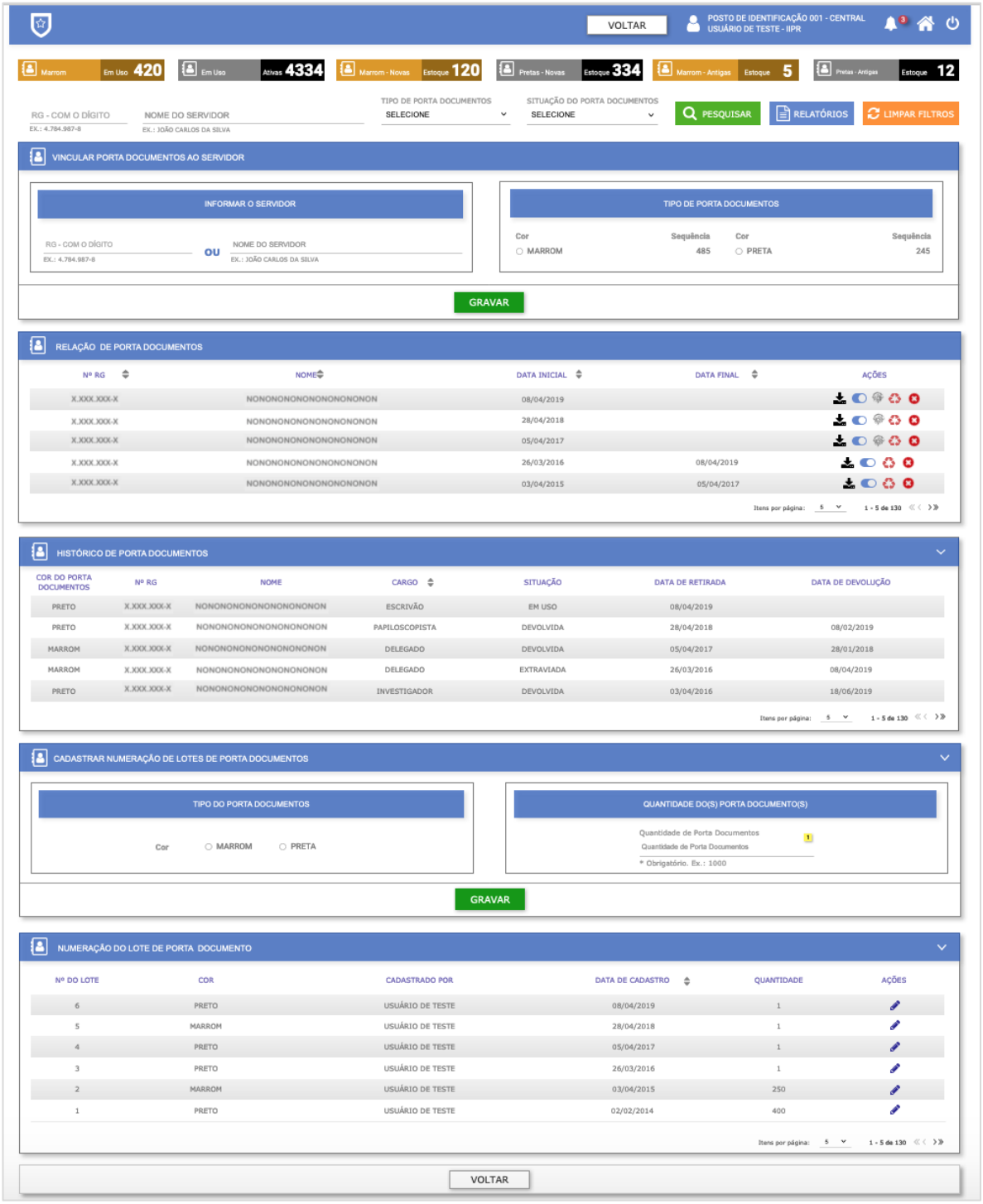
3. MAINTAIN SEAL



4. MAINTAIN INSIGNEA



5. DOCUMENT HOLDER



ANNEX A – meCUE QUESTIONNAIRE

1. **Module I** - Perception of instrumental qualities.

STATEMENTS	DEGREE OF AGREEMENT						
	strongly disagree	**disagree**	**somewhat disagree**	**neither agree nor disagree**	**somewhat agree**	**agree**	**strongly agree**
The product is easy to use.	O	O	O	O	O	O	O
The functions of the product are exactly right for my goals.	O	O	O	O	O	O	O
It is quickly apparent how to use the product.	O	O	O	O	O	O	O
I consider the product extremely useful.	O	O	O	O	O	O	O
The operating procedures of the product are simple to understand.	O	O	O	O	O	O	O
With the help of this product I will achieve my goals.	O	O	O	O	O	O	O

2. **Module II** - Perception of non-instrumental qualities.

STATEMENTS	DEGREE OF AGREEMENT						
	strongly disagree	**disagree**	**somewhat disagree**	**neither agree nor disagree**	**somewhat agree**	**agree**	**strongly agree**
The product is creatively designed.	O	O	O	O	O	O	O
The product would enhance my standing among peers.	O	O	O	O	O	O	O

I could not live without this product.	O	O	O	O	O	O	O
The design looks attractive.	O	O	O	O	O	O	O
By using the product, I would be perceived differently.	O	O	O	O	O	O	O
The product is like a friend to me.	O	O	O	O	O	O	O
The product is stylish.	O	O	O	O	O	O	O
If I ever lost the product, I would be devastated.	O	O	O	O	O	O	O
I would not mind if my friends envied me for this product.	O	O	O	O	O	O	O

3. **Module III** - User emotions.

STATEMENTS	DEGREE OF AGREEMENT						
	strongly disagree	**disagree**	**somewhat disagree**	**neither agree nor disagree**	**somewhat agree**	**agree**	**strongly agree**
The product exhilarates me.	O	O	O	O	O	O	O
The product makes me tired.	O	O	O	O	O	O	O
The product annoys me.	O	O	O	O	O	O	O
The product relaxes me.	O	O	O	O	O	O	O
When using this product I feel exhausted.	O	O	O	O	O	O	O
The product makes me feel happy.	O	O	O	O	O	O	O
The product frustrates me.	O	O	O	O	O	O	O

The product makes me feel euphoric.	O	O	O	O	O	O	O
The product makes me feel passive.	O	O	O	O	O	O	O
The product calms me.	O	O	O	O	O	O	O
When using this product, I feel cheerful.	O	O	O	O	O	O	O
The product angers me.	O	O	O	O	O	O	O

4. Module IV - Consequences of use.

STATEMENTS	DEGREE OF AGREEMENT						
	strongly disagree	**disagree**	**somewhat disagree**	**neither agree nor disagree**	**somewhat agree**	**agree**	**strongly agree**
If I could, I would use the product daily.	O	O	O	O	O	O	O
I would not swap this product for any other.	O	O	O	O	O	O	O
I can hardly wait to use the product again.	O	O	O	O	O	O	O
In comparison to this product, no others come close.	O	O	O	O	O	O	O
I would get exactly this product for myself (again) at any time.	O	O	O	O	O	O	O
When using the product, I lose track of time.	O	O	O	O	O	O	O

5. Module V - Overall evaluation.

How do you experience the product as a whole?

ANNEX B – TAM PROTOCOL

1. Initial scale items for Perceived Usefulness.

STATEMENTS	DEGREE OF AGREEMENT						
	strongly disagree	**disagree**	**somewhat disagree**	**neither agree nor disagree**	**somewhat agree**	**agree**	**strongly agree**
1.My job would be difficult to perform without the new approach **(UXIAD)**.	O	O	O	O	O	O	O
2.Using the new approach **(UXIAD)** gives me greater control over my work.	O	O	O	O	O	O	O
3.Using the new approach **(UXIAD)** improves my job performance.	O	O	O	O	O	O	O
4.The new approach **(UXIAD)** addresses my job-related needs.	O	O	O	O	O	O	O
5.Using the new approach **(UXIAD)** saves me time.	O	O	O	O	O	O	O
6.The new approach **(UXIAD)** enables me to accomplish tasks more quickly.	O	O	O	O	O	O	O
7. The new approach **(UXIAD)** supports critical aspects of my job.	O	O	O	O	O	O	O
8.Using the new approach **(UXIAD)** allows me to accomplish more work than would otherwise be possible.	O	O	O	O	O	O	O
9.Using the new approach **(UXIAD)** reduces the time I spend on unproductive activities.	O	O	O	O	O	O	O
10.Using the new approach **(UXIAD)** enhances my effectiveness on the job.	O	O	O	O	O	O	O
11.Using the new approach **(UXIAD)** improves the quality of the work I do.	O	O	O	O	O	O	O

12.Using the new approach **(UXIAD)** increases my productivity.	O	O	O	O	O	O	O
13.Using the new approach **(UXIAD)** makes it easier to do my job.	O	O	O	O	O	O	O
14.Overall, I find the new approach **(UXIAD)** useful in my job.	O	O	O	O	O	O	O

2. Initial scale items for Perceived Ease of Use.

STATEMENTS	DEGREE OF AGREEMENT						
	strongly disagree	**disagree**	**somewhat disagree**	**neither agree nor disagree**	**somewhat agree**	**agree**	**strongly agree**
1.I often become confused when I use the new approach **(UXIAD)**.	O	O	O	O	O	O	O
2.I make errors frequently when using the new approach **(UXIAD)**.	O	O	O	O	O	O	O
3.Interacting with the new approach **(UXIAD)** is often frustrating.	O	O	O	O	O	O	O
4.I need to consult the user manual often when using the new approach **(UXIAD)**.	O	O	O	O	O	O	O
5.Interacting with the new approach **(UXIAD)** requires a lot of my mental effort.	O	O	O	O	O	O	O
6.The new approach **(UXIAD)** is rigid and inflexible to interact with.	O	O	O	O	O	O	O
7.I find it cumbersome, to use the new approach **(UXIAD)**.	O	O	O	O	O	O	O
8.My interaction with the new approach **(UXIAD)** is easy for me to understand.	O	O	O	O	O	O	O
9.It is easy for me to remember how to perform tasks using the new approach **(UXIAD)**.	O	O	O	O	O	O	O

10. The new approach **(UXIAD)** provides helpful guidance in performing tasks.	o	o	o	o	o	o	o
11.Overall, I find the new approach **(UXIAD)** easy to use.	o	o	o	o	o	o	o