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UCD Sprint: A Fast Process to Involve Users in the Design Practices of Software Companies

Marta K. Larusdottir[a]*

Rosa Lanzilotti[b]

Antonio Piccinno[b]

Ioana Visescu[a]

Maria Francesca Costabile[b]

[a]Department of Computer Science, Reykjavik University, Reykjavik, Iceland, marta@ru.is;

[b]Department of Computer Science, University of Bari Aldo Moro, Bari, Italy

UCD Sprint: A Fast Process to Involve Users in the Design Practices of Software Companies

Several studies have shown that involving users in design processes is a key factor in understanding user needs and essential for designing computer systems capable of providing valuable user experiences. However, many practitioners do not emphasize user needs sufficiently and neglect user involvement in software design and development. The UCD Sprint is a recently proposed, step-by-step, cost-effective process that focuses on involving users in design activities. This article reports a mixed-method study in which, for the first time, practitioners working in companies used the UCD Sprint; the study's main objective was to investigate the impact of the UCD Sprint on practitioners' design practices. The results show that, among the various activities associated with this process, those that involved users were particularly appreciated by practitioners. Thus, the UCD Sprint can enhance the innovativeness of company design practices; it enables practitioners to obtain sufficient information to create systems that fit users' needs.

Keywords: User-centred design, User involvement, Empirical study, User experience, Software design

Subject classification codes: Human-centred computing ~ Interaction design ~ Interaction design process and methods ~ User-centred design

1 Introduction and Motivation

The benefits and drawbacks of involving users in software development in a face-to-face setting to understand their needs and expectations more accurately have been explored by researchers for several years. A literature review published in 2003 claimed that user involvement generally has positive effects, especially on user satisfaction with the delivered system (Kujala, 2003). Bano and Zowghi report that user involvement positively affects software system success (Bano & Zowghi, 2015), i.e., it permits the

desired benefits to be obtained if it is carefully planned and managed. Additionally, Maramba et al. (2019) found that involving users in testing eHealth apps has increased in recent years, thereby providing valuable results. Despite these positive results, practitioners face several challenges when involving users in their software design, namely, a lack of support from top management, a lack of resources, a lack of good communication and lack of qualified user experience professionals (Inal et al., 2020). Another study showed that user experience (UX) professionals struggle to position themselves within their company and prove that their methods and techniques are valuable (Marsden & Holtzblatt, 2018). To address these challenges, practitioners expect more support from top management, more money, better internal cooperation, better organization-wide tools, and more training on user-centred design (UCD). While the field of Human-Computer Interaction (HCI) offers many methods to help understand users, designers often view themselves as proxies for or representatives of intended users when assessing their needs and requirements (Islind, Lundh Snis, 2018).

The User-Centred Design Sprint (UCD Sprint for short) was recently proposed by Roto et al. (Roto et al., 2021). It is a step-by-step and cost-effective process that emphasizes user involvement in the early stages of software design. Eighteen UCD steps are included in the process, which also defines how the results of one step are used in subsequent steps. The main objective of the process is to involve users from the very beginning of software development to discover their needs and expectations and to generate different ideas based on this information to create early interface designs, which are evaluated through quick and informal formative user testing. The UCD Sprint originated from experiences in intensive courses with university students (Larusdottir et al., 2018; Larusdottir et al., 2019; Roto et al., 2021). Participants in these courses claimed that the process was fast, focused, and structured but also gave them time for

reflection (Roto et al., 2021). The UCD Sprint has also been taught in short courses at conferences (Larusdottir et al., 2021; Larusdottir et al., 2022; Larusdottir et al., 2023).

The motivation for our research is to promote user involvement and UCD activities in the design processes of software companies as well as in the context of public administration because these activities are key elements in the creation of systems that are capable of meeting users' needs. Previous research on the design practices of software companies has highlighted how infrequently UCD activities are performed; moreover, time and costs have often been cited as reasons that deter practitioners from involving users in design and development processes (see, e.g., (Ardito et al., 2014; Ardito et al. 2014a; Teka et al., 2017)). The UCD Sprint has received positive feedback from university students, but the implementation of this process has not yet been studied in the context of practitioners. We wanted to explore whether and how practitioners can apply the UCD Sprint process to their software design. Thus, we performed a study whose overall research question focused on whether the UCD Sprint process is valuable with regard to providing UCD activities that involve users and are feasible for practitioners to introduce into their software design practices. It is the first study carried out by one of the researchers who defined the UCD Sprint in which practitioners have been involved.

As reported in this article, the study was conducted in accordance with a research methodology featuring three parts. In the first part, semi-structured interviews were conducted with 7 practitioners to understand their current ways of working, and how they involve users in their software design practices. In the second part, 14 practitioners attended a course on a new version of the UCD Sprint, during which they performed the activities of the process; the course was organized in a novel way, and it lasted 4 days to account for the time constraints faced by companies' employees;

feedback was collected from participants to provide both quantitative and qualitative data that could enable us to understand how they valued the activities of the UCD Sprint process as well as the course structure and content. In the third part of the study, 8 course participants were interviewed seven weeks after the course with the goal of understanding how they envision the future implementation of the UCD Sprint process in their design approaches. The study results highlight the value of the UCD Sprint with regard to focusing on software users, who are the main stakeholders whom designers must address when developing software that is capable of providing good user experiences.

The paper is organized as follows. Section 2 reports related work. Section 3 describes how the UCD Sprint has evolved since its original conception and how a course on the UCD Sprint has been crafted to be suitable for practitioners. Section 4 describes the study conducted, and Section 5 discusses the results obtained thereby. Section 6 describes the limitations of the study, and Section 7 concludes the article while simultaneously highlighting future work that can address some of the limitations of this study.

2 Related Work

This section first describes some literature on the approaches and methods used to involve users in software design and on how that is accomplished in practice; then, it reports the results of studies on the integration of UCD methods in agile processes; and finally, it briefly describes the design sprints that inspired the UCD Sprint.

2.1 The Implementation of UCD Methods in Practice

Designing software based on an inappropriate or incomplete understanding of user needs due to a lack of user input is a major source of unusable software (e.g., ISO,

2020; Hussain et al., 2016). Several approaches, methods and processes for focusing on and involving users have been suggested to improve the understanding of various factors pertaining to users and their involvement in the software being designed. The most cited process in this context is the Human-Centred Design (HCD) process, which is also referred to as User-Centred Design (UCD) process and was illustrated in ISO (2020). It includes four major activities: (a) understanding and specifying the context of use; (b) specifying the user requirements; (c) producing design solutions to meet these requirements; and (d) evaluating the designs against the requirements. These major activities are quite broad, so IT professionals must select UCD methods and techniques that are sufficiently detailed to perform the major activities stipulated in the standard.

A recent study identified the UCD methods that are most frequently used by UX professionals, i.e., professionals who focus on users' needs and UX (Inal et al., 2020). The typical UX professional included in that study had more than a decade of work experience working in small teams using agile development processes within large organizations. The study involved 422 participants from 5 countries. More than 70% of the participants noted that they followed a UCD process, and more than 80% claimed that they focused on user experience. The most frequently used standard UCD methods pertained to prototyping, namely, wireframing, sketching, mockups, and digital prototyping. Two-thirds of the participants reported engaging in face-to-face contact with end users. The most common UCD method for this contact was usability testing featuring three or more rounds, and six or more users in total were included in such projects. Three out of four UX professionals followed up with the development teams after completing the UCD activities. UX professionals found it to be difficult to choose among the various UCD methods available and asked for more structured ways of working.

Often, the UCD methods used to gather user requirements, such as interviews, questionnaires, and observations, are viewed in the industry as resource-consuming (Ardito et al., 2014). Partnerships between universities and industry have been suggested in an attempt to educate students in UCD practices more effectively (Getto & Beecher, 2016). Approaches such as design sprints and agile processes can productively incorporate structure and speed into design processes, combining the needs of the professionals with those of users, given that the focus is kept primarily on the user and UCD methods are well integrated into time-bound sequences.

2.2 Integrating UCD Methods into Agile Processes

Since the beginning of this century, researchers have investigated the combination of UCD with agile design methodologies: both approaches are based on similar principles, namely, user involvement, iterative design, continuous testing and prototyping (Blomkvist, 2005). Some studies have indicated that the UCD-agile combination poses two important problems. The first such problem pertains to communication between developers and designers. Developers are more focused on software architecture and functionality, while designers are more focused on user requirements (see, e.g., (Chamberlain et al., 2006)). The other problem pertains to the distinction between two different actors who might be involved in this process: customers and users. In most cases, these two actors are very different: the customer is the person who requires the system and is paying for its development, while users are those who will use the system. Agile methodologies usually require customer participation in the software lifecycle only as part of a collaborative partnership based on daily interaction with developers and a lack of user participation (Highsmith, 2002). UCD is primarily based on user involvement in the software lifecycle. Often, customers do not know users' needs, expectations, and desires well; thus, user requirements expressed solely by customers are insufficient for

creating products that are capable of exhibiting a positive UX. In the literature, some studies have explored fruitful customer and user participation in agile software development projects (Kautz, 2011). In these studies, customers played an informative, consultative and participative role, while users guaranteed the appropriate flexibility of the product during the whole design and development process. The result was very good: both the project and the final product were considered to be a success by the customer and the developing organization.

The integration of UCD methods into agile development has been discussed in the literature (see, e.g., Cockton et al., 2016; Ardito et al., 2017; Bruun et al., 2018; Persson et al., 2022). In particular, in a study conducted at a software development company in Denmark with a focus on the UX of their software, a total of 10 IT professionals, including UX professionals, developers, and managers, were interviewed about user involvement in their software development process (Bruun et al, 2018; Persson et al., 2022). The primary outcome indicated that UX professionals typically work full-time on projects during the inception and requirement-gathering phase before the agile development process is initiated. During these implementation sprints, the UX professionals typically spend 20% of their time on the projects, which mostly involves guiding the development team when questions arise regarding implementing sketches or wireframes and only occasionally involves users.

2.3 Design Sprints

Processes for helping developers in the early steps of design have been identified. These processes include design sprints, in which context a dedicated team solves certain questions, challenges or uncertainties by making prototypes and testing them with target users (Larusdottir et al, 2023). One such process was popularized by the IDEO design agency as a human-centred and efficient way of promoting innovation in 2010 (Brown &

Wyatt, 2010). While academics have criticized this process for failing to build on design theories, the practical guidance people can obtain from this approach has been popular in innovation-oriented organizations. Another process called *Design Sprint* was proposed by Knapp et al. (2016). This process consists of a step-by-step collaborative design process involving seven or fewer people with different backgrounds, such as management, finance, marketing, customer research, and technology. The Design Sprint is scheduled in detail over a period of 5 days, Monday to Friday (Knapp et al., 2016). A facilitator who has experience with the sprint process guides the team by providing specific instructions and timing for each activity. On the first day, the Design Sprint focuses on mapping out the whole idea and discussing it with experts; the next day, a small part is selected for further work, and the interaction design starts; the third day, the focus is on designing the flow of the interaction; and the fourth day, a detailed prototype is created. Users are involved during the final day of the Design Sprint in through five 30-minute user testing sessions, which are analyzed during the final afternoon of the sprint. The process includes both team discussions and individual idea development. It has been argued that a fixed schedule for the Design Sprint ensures that the work remains productive and fast, and through sprints, feasible solutions can be explored (Knapp et al, 2016).

Design sprints take place before implementation starts, i.e., during the phase that involves defining what to implement, unlike sprints in the context of agile processes, which have the main goal of implementing software (Swaber and Beedle, 2002). Once a design sprint has found a promising candidate solution, an agile development project can start and implement the digital parts of the solution. Both design and implementation sprints share the mindset of avoiding wasting time by planning too far ahead. Instead, they wait to plan the details until the team is ready to focus on them and

keep the design to a minimum at the beginning of the project (Adikari, et al., 2009). In both cases, it is essential to accept a state of uncertainty regarding how well the design fits the users and how good the overall idea is. Additionally, learning from each iteration is emphasized (Knapp, et al., 2016).

Leading researchers in the UCD field have studied how UCD activities and design sprints can be merged (Larusdottir et al. 2019). A process called the *UCD Sprint* has been defined (Roto et al., 2021). The main objective of the UCD Sprint process is to focus on users and their needs, more than is done in Knapp's Design Sprint process (Knapp et al., 2016) or the IDEO design sprint process. Another objective pertains to the integration of good design practices drawn from Knapp's Design Sprint into the UCD Sprint.

3 The UCD Sprint Process

In this section, we describe the evolution of the UCD Sprint. We also illustrate how a course on this process has been structured for practitioners working in IT companies to fit their needs more effectively.

3.1 Evolution of the UCD Sprint Process

The UCD Sprint process originated from the addition of UCD activities to Knapp's Design Sprint. Two versions were tested in two-week intensive courses in higher education. In the first version, Knapp's Design Sprint was conducted during the first week, while more specialized UCD activities were conducted during the second week, as described by Larusdottir et al. (2019). Specifically, the added activities included stating UX goals, redesigning the prototypes to fit the UX goals, evaluating the UX, redesigning it according to the results and evaluating it once again. The three activities that were ranked the highest in terms of being useful during the course were a) sketching, including

the Crazy 8 activity used in the UCD Sprint to sketch different ideas, b) creating a storyboard to design the flow from one screen to another in the prototype and c) making high-fidelity prototypes. The lowest scores were given to setting UX goals since participants commented that this activity took place too late. Additionally, participants noted that more user interaction should happen at the beginning of the process.

In the second version of the course, some UCD activities, namely, sketching a vision, analyzing user groups, conducting interviews with users, identifying UX goals and identifying usability requirements, were conducted before Knapp's design sprint activities. This structure was based on the feedback obtained from the previous version of the course. After the activities described in Knapp's design sprint, the prototypes were iterated according to the results of the user evaluations and evaluated once again. The feedback from participants during that course was positive with regard to the whole process, i.e., both the UCD part and Knapp's Design Sprint part. The process was called *UCD Sprint* (Roto et al., 2021). The course activities that received the highest rating with regard to being useful were high-fidelity prototyping and user evaluations of high-fidelity prototypes.

The goal of the UCD Sprint process is to involve users from the beginning of software design to enhance the designers' understanding of user needs. This approach is especially applicable when the idea for the software is unexplored and the potential users have various backgrounds, unlike the developers. At INTERACT 2021, a course was also held to explain the UCD Sprint process to conference participants (Larusdottir et al., 2021). Because of limited time, the course focused on introducing the process and practicing two steps of the process. Subsequent discussions with academics working in the field of HCI and further experiences led to a new version of the UCD Sprint process, which is illustrated in Figure 1. The UCD Sprint is now organized into three phases, i.e.,

Discovery, Design and Reality Check, each of which includes 6 steps; UCD activities are performed at each step.

The process is not bound to any particular timing or linked to particular days of the week; thus, it is more flexible than Knapp's Design Sprint. Additionally, the UCD Sprint is a step-by-step process that offers developers a structured way to involve users on 3 occasions, i.e., during interviews, during low-fidelity prototype evaluation and during high-fidelity prototype evaluation. The initial involvement of users occurs already at the third step of the 18-step process. In Knapp's Design Sprint, users are involved only in testing high-fidelity prototypes as one of the last activities in the process. Furthermore, the UCD Sprint process has been refined in light of findings from previous studies on UCD activities and the experience obtained during courses (Jia et al., 2012; Larusdottir et al., 2019; Roto et al., 2021). This version of the UCD Sprint process has been presented during a tutorial at NordiCHI 2022 (Larusdottir et al, 2022) and in a course at CHI 2023 (Larusdottir, et al., 2023).

<< Insert Figure 1. Here>>

Figure 1: An overview of the structure of the UCD Sprint.

As shown in Figure 1, the UCD Sprint spends ample time understanding the needs of the target user group. Interviews are conducted with users before the prototyping starts. UCD Sprint differs from a more general UCD process by providing a clear structure and methods for each step of the design process. Like Knapp's Design Sprint, the step-by-step process of UCD Sprint allows less experienced teams to apply the methodology, so it also fits well in the context of design education. The UCD Sprint was developed through intensive interaction design courses in which students with different backgrounds worked on design challenges in teams. The original UCD Sprint process is two weeks long and

includes time for teaching the methods. When applied by professional developers who are familiar with UCD methods, the process can be shorter.

3.2 UCD Sprint Course for Practitioners

Our research aims to promote user involvement and UCD activities to practitioners, particularly in the design processes of software companies. Therefore, we decided to structure a new course on the UCD Sprint that could enable practitioners to understand how useful they would find the UCD Sprint both during the course and for future integration in their design processes. Our experience with IT companies provided evidence suggesting that corporate practitioners know very little or nothing about the UCD methods; thus, it was decided that the course should entail some practice on the UCD activities used in the UCD Sprint. However, practitioners usually face strict time constraints, so it was clear to us that we could not offer a 10-day course but should rather modify the course structure to suit practitioners' needs. Ultimately, the course was designed to be taught for 4 days with assigned homework between course days. An overview of the activities in the UCD Sprint course for practitioners is provided in Figure 2.

<< Insert Figure 2. Here>>

Figure 2: An overview of the UCD activities conducted during the UCD Sprint course and their timing.

This course was offered as part of the study reported in Section 4. More specifically, this course was organized as follows. Each course day started at 9:00 and continued until 17:00, including breaks as needed, usually one in the morning, one for lunch, and one in the afternoon. The first day was a Thursday, the second was a Friday, the third was a Tuesday the following week and the last day of the course was a Wednesday. Hence, the

participants first had two course days in succession and were assigned homework in the evening both days (see Figure 2).. The third and fourth days followed in succession. At the beginning of the course, the first task for the participants' groups was to select a design idea on which they wanted to work during the four days of the course. They were given 5 design ideas, three of which were chosen. The course covered 16 out of the 18 steps in the UCD Sprint process (see Figure 1). The steps "Design brief" in the Discovery phase and "Happy paths" in the Design phase were not covered because of practitioners' strict scheduling requirements.

The participants were asked to provide quick feedback on the benefits, drawbacks and potential improvements at the end of the second day of the course to enable us to correct any flaws thus identified directly. Generally, the participants commented positively on the course structure, the cooperative and activity-based learning approach, and the UCD Sprint process; thus, no revision of the course structure was needed.

4 UCD Sprint for Practitioners: The Study

This section describes the study conducted with practitioners working in Italian software companies. First, Section 4.1 describes the objectives of the study, specifying the research questions and illustrating the research methodology adopted for the study, which is organized in three parts. Then, Sections 4.2, 4.3 and 4.4 report the details of participants, methods and results of the three parts of the study, respectively.

4.1 Study Objectives, Research Questions and Methodology

The main objective of the study was to investigate whether the UCD Sprint is a valuable process that practitioners can adopt for focusing on and involving users in their software design practices. Since it was the first time that the course on the UCD Sprint was offered

to practitioners, a secondary objective was to investigate the positive and negative aspects of the course from the perspective of participants. More specifically, our study explored the following research questions:

(1) What are practitioners' current ways of working; specifically, how do they address users and involve them in their software design practices? (RQ1)
(2) How do practitioners rate the usefulness of the UCD Sprint process? (RQ2)
(3) What do practitioners consider to be the positive and negative aspects of the UCD Sprint course? (RQ3)
(4) How do practitioners envision the future implementation of the UCD Sprint process in their design approaches? (RQ4)

The study was guided by a research methodology featuring three parts, as shown in Figure 3. In Parts 1 and 3, semi-structured one-on-one interviews were conducted to address RQ1 and RQ4, respectively. In Part 2, to address RQ2 and RQ3, 14 practitioners attended a 4-day course on the new version of the UCD Sprint described in Section 3.2, as part of which they performed the activities associated with the process.

<< Insert Figure 3. Here>>

Figure 3: The study methodology consisting of three parts.

The participants, data gathering, data analysis and results of each of the three parts of the study are reported in sections 4.1, 4.2 and 4.3, respectively.

4.2 Part 1: Current Ways of Working

Semi-structured interviews were conducted with 7 employees involved in the design/development of their company products. The interviews were conducted from November 2021 to January 2022. Their aim was to address RQ1: *What are practitioners'*

current ways of working; specifically, how do they address users and involve them in their software design practices?

4.2.1 Participants, Data Gathering and Data Analysis

The 7 participants were selected through convenience sampling: we contacted company managers who indicated the person(s) involved in the design/development practices of their company. Of the 7 participants in this study, 2 identified themselves as development managers, 2 as user interface and UX (UI/UX) managers, and 1 as a developer; the remaining 2 participants noted that they are professional service (PS) managers, i.e., people who interact with customers to define product requirements. Interviewees signed a digital consent form that informed them about the collection of audio recordings and the management of sensitive data. Interviewees were not given any remuneration or reward for participating in this study.

The interviewees worked at 4 companies operating in the area around [particular place, country]. Companies with different characteristics were intentionally selected. One employee from the smallest company was interviewed, and two employees from the other three companies were interviewed. The smallest company had 16 employees, most of whom were developers, and a turnover of fewer than 1 million Euros. Its core business was software system design and development, but it also focused on industrial research, Information and Communications Technology (ICT) consulting, and e-Health applications. The second company had 40 employees and a turnover of approximately 2.2 million Euros. It had two offices in Italy and one in the UK as well as multiple international partnerships. This company focused on creating software to support laboratories in managing tests of their products. The other two companies were larger. One of these companies was among the leading Italian players in international business consulting and system integration; this company had approximately 2000 employees

(800 in the [city] office) and a turnover of approximately 170 million Euros. It delivered software solutions of different types, such as solutions pertaining to financial services, energy and utilities, transportation, public administration, and international institutions. The fourth company was a global leader in IT professional resourcing; it had approximately 1500 employees (67 in the [city] office) and a turnover of 440 million Euros. Its products were primarily focused on the fields of IT, transportation, and automation.

The semi-structured interview was composed of 5 sections. After welcoming the interviewee, the first section asked about the interviewee's role in the company, the type of software products that the company develops, the development approach used to create the company's products in terms of models, methods, and activities, whether they take users' needs into account and which activities they perform to collect information regarding those needs. The second section was related to UX; specifically, we asked interviewees to report whether they investigate how their users experience their products in terms of, for example, ease of use, engagement, satisfaction, or esthetics. The questions in the third section investigated whether and how interviewees perform activities aimed at identifying the tasks that end users will perform using the future product. The fourth section concerned how they address the user interface design and, in particular, the possible use of prototypes and tools to develop them. The fifth section pertained to the evaluation activities performed to investigate the quality of the software products they create and whether and how they have previously involved users.

Two researchers were involved in each interview: one researcher served as the interviewer, and the other researcher assisted by taking notes. The interviews were audio-recorded. Each interview was transcribed before analysis.

Inductive thematic analysis was used to analyze the data collected during the interviews. Themes were identified through in vivo coding. More specifically, two researchers independently analyzed the interview transcripts to identify patterns, opinions, and behaviours as well as other issues that sound interesting, grouping them in themes that synthetically describe each group. As required in this kind of analysis, 70% of the results were double-checked for interrater reliability. The analysts ultimately reached consensus regarding all the identified themes. The same process was adopted in the analysis of the qualitative data of Part 2 and Part 3 of the study.

4.2.2 Results Regarding Current Ways of Working

The identified themes are summarized in Table 1 alongside their definitions and the main results that emerged from the analysis. The results are reported for each theme.

Table 1: Overview of the themes, their definitions and the main results

Themes	Definition	Main results
Process	The process that the company uses to develop its products	● All companies follow an agile-based design/development process.
Requirements	Approaches that the company uses to collect project requirements	● Requirements are defined in collaboration with the customer. ● Requirements are possibly integrated with other requirements derived from the experience of the company with other products.
Prototyping	Use of prototypes and their types	● Little use of prototypes. One company uses mockups. ● Prospective users are never involved.
Evaluation and Test	Types of evaluations and tests that the company performs	● Functional tests are always performed on the products. ● In one case, the product was evaluated by the customer, who was also an end user of the product. ● Some evaluation of the released product is conducted.
User Involvement	Involvement of the users in the different phases of the development process	● Users are not involved in the product development. ● Only when the product is released do users interact with the product and can provide feedback. ● User involvement is too expensive.

Process. Regarding this first theme, the analysis of the answers provided by the interviewees showed that all the companies employ an agile-based development process. After the company and the customer agree to develop the product, the first activity is a kickoff meeting at which the company PS manager and his team meet with the customer to discuss and agree upon the initial set of product requirements.

Requirements. Interviewees noted that requirements are defined in collaboration with the customer; no interviewees claimed that users are involved in the analysis of requirements. The company can suggest other requirements based on the experience it has acquired in previous projects. The customer can choose whether to approve the new requirements, and in the end, a document containing specific requirements is produced and signed by the customer. As one interviewee explained, "*The defined requirements could also change later based on feedback received from users once they work with the released product*" (*PS manager*; note that the words in parentheses after each excerpt indicate the role of the interviewee). However, in these cases, such changes are not formally reported but merely communicated to the development team. In most cases, the focus is on functional requirements. Three interviewees noted that they identify user needs; however, such needs are identified in consultation with the customer. One interviewee remarked that the customer *"plays the role of the final user"* (UI/UX manager). As another interviewee said, "*User profiles are defined, and for each of them, a user journey is written*" (Manager). User journey is a method that companies often use to describe the experience that users will undergo within a given scenario (Endmann & Kessner, 2016); consequently, different use cases are defined and discussed within the team. Initially, a user journey is described in an Excel file with a requirement/user table, following which

it is described in detail using PowerPoint slides. These slides are shared with the UI/UX expert of the company, who is responsible for the UI design.

Prototyping. Only one interviewee made the following claim: *"In my company, mockups are used, especially when important or complex requirements are difficult to explain using words*. *The mockups are sent to the UI/UX manager, who, using Figma*[1] *or Balsamiq*[2]*, creates running prototypes, which are then checked with the PS team*" (PS manager). It is worth noting that the PS manager used the terms "usable interaction"; however, when she was asked about the meaning of these two words, she said only that a low number of clicks is an indicator of good usability. This finding shows that some practitioners do not completely understand the meaning of usability. If the UI/UX manager believes that the mockups produced by the PS team are insufficient, they can produce new prototypes from scratch; such prototypes are discussed with the PS teams. An initial brainstorming session takes place at which the UI/UX manager explains the pros and cons of the various proposals with the goal of understanding possible obstacles or factors that might be encountered in the development phase. When a consensus is reached regarding the final prototype, it is shared with the PS manager and the development team. Prototypes are generally evaluated within the company itself. The prospective user is never involved.

As one interviewee from another company said, *"The prototypes are presented as a demo in an informal meeting with both the PS team and the support service team; these people provide feedback based on their experience" (*PS manager). This presentation is considered to be a fruitful activity, but as another interviewee

[1] https://www.figma.com/

[2] https://balsamiq.com/

emphasized, *"Unfortunately, COVID and smart working have stopped this activity!" (*Manager).

As one interviewee who works as a developer in a company noted, "*I receive the requirements for a new product and start developing the product using the final technology"* (Developer). The UI/UX manager of the same company claimed that "*I'm moved from one project to another when it is time to develop or redesign the interface."* Her name is Maria; as she said, *"When they talk about UX, they call Maria!"* She added that *"The role of the UX expert is confused with the role of the graphical designer"* (UI/UX manager), highlighting the fact that UX is not properly considered while the company focuses only on the product's visual appearance.

Evaluation and Test. The results regarding this theme show that before each product release, which occurs periodically (e.g., every week, every two weeks, or monthly), no evaluation with users is performed; rather, only functional tests are performed to fix possible bugs. Once the users work with the final product, they might send feedback to the development team by email or phone; in a few cases, this feedback is discussed in meetings between the PS team and the customer. Indeed, as one interviewee noted, *"The problems arise during the pre-go-live phase when users use the system"* (PS manager). Another interviewee noted that *"The real work begins after the final system is released"* (Manager). The same interviewee commented that even if the customer was involved during the design and development phases, *"The problems emerged only when the users started using the product*"; he added that *"the solutions to the problems had to be implemented in the new software release."* It is worth remarking that, despite all these concerns, users are still not involved in the design/development process.

User Involvement. In general, interviewees claimed that there is no user involvement during the early sprints; in the pre-go-live and go-live phases, the customer plays the role of the end user. In an ongoing project in one company, the customer is also the end user. As an interviewee from that company noted, "*Different prototypes of the product were evaluated with the customer during the biweekly meetings*" (PS manager). He also explained that each meeting was divided into two phases: a first phase in which the PS team showed the prototype, highlighting the improvements made based on the suggestions received at the previous meeting, and a second phase in which the customer used the prototype and provided new feedback. As this interviewee said, *"Being that the customer is also the user, it was also very important for him to define user needs. This work must be done by four hands!"* (PS manager).

The interviewees offered several reasons to explain the exclusion of users from the development process, which are already well known in the literature (Ardito et al., 2014a). User involvement is still viewed as *"too expensive*" (Manager) and resource-demanding both in terms of time and difficulties in user recruitment. As one interviewee said, *"We don't involve end users because of time issues and because misunderstandings can be created"* (UI/UX manager). Another interviewee exclaimed that *"The user requires 3000 things!"* (Manager). As one manager said, *"In the end, the customer decides, not the users."*

4.3 Part 2: Usefulness of the UCD Sprint

The main goal of the second part of the study was to address both *RQ2: How do practitioners rate the usefulness of the UCD Sprint process?* and *RQ3: What do practitioners consider to be the positive and negative aspects of the UCD Sprint course?* Practitioners were invited to participate in the 4-day course on the UCD Sprint described in Section 3.2, which was held at the [Particular University, particular place] on April

28th and 29th and May 3rd and 4th, 2022. All authors contributed to the course, although they played different roles, and they did not receive any remuneration for the course.

4.3.1 Participants, Data Gathering and Data Analysis

The course had 14 participants, including four females and ten males between the ages of 24-42; they were selected through convenience sampling to ensure that practitioners could attend the four-day course. For the interviews, we contacted the companies' managers, and with their participation, we selected the practitioners who were most suitable to participate in the course in terms of both competence and availability. The participants had mixed personal and educational backgrounds. Specifically, 4 participants were employed full-time at IT companies as designers/developers, 8 were designers/developers working part-time at IT companies while pursuing their PhDs in Computer Science (industrial PhDs), 1 had a background and a strong interest in UCD and was working as a freelancer while pursuing his Computer Science studies, and 1 was a freelancer with experience in graphic design. The participants were split into 3 working groups to ensure a varied mix of backgrounds in each group. All participants signed a digital consent form that informed them about the management of any sensitive data collected. Participants were not given any remuneration or reward for participating in this study.

Data were gathered at the end of the course using a questionnaire that featured four parts: 1. participants' backgrounds; 2. positive and negative aspects of the course as perceived by participants; 3. participants' ratings of the usefulness of the steps involved in the UCD Sprint process covered in the course; and 4. participants' overall experiences during the course. Each part was presented on one page.

The questions concerning participants' backgrounds in Part 1 included both open and closed questions that aimed to collect information regarding participants'

educational backgrounds, work backgrounds and experience as well as some demographic data, including their age and gender. The data thus collected are summarized in the description of participants above.

To answer RQ2, Part 3 was a formal questionnaire that collected participants' ratings of the usefulness of each step of the UCD Sprint process performed during the course. The questions asked were as follows: 1) Was it [the step] thought-provoking? 2) Was it [the step] useful for the course? 3) Do you think that you will use this method in your job/education? The participants evaluated these dimensions on a scale from 1 to 7, from "Not at all" to "Extremely so", and "Not likely" to "Extremely likely", respectively. This part of the questionnaire has also been used in other iterations of a course on UCD Sprint (Larusdottir et al., 2019; Roto et al., 2021). The raw data collected through Part 3 were inserted into an Excel file to calculate the average ratings, which are discussed in Section 4.2.2.

Parts 2 and 4 of the questionnaire were used to gather data to answer RQ3. In Part 2, qualitative data were collected using the Retrospective Hand technique, which is an informal qualitative questionnaire that features 5 items and has also been used in previous courses (Larusdottir et al., 2019; Roto et al., 2021). The participants were asked to provide feedback regarding of the course aspects that captured their attention. More specifically, the participants were asked to describe their experiences in the UCD Sprint course according to the following five categories: 1) This was good; 2) I want to point this out; 3) This was not as good; 4) I will take this home; and 5) I would have liked more of this. In Part 4 of the questionnaire, the participants could provide any comments they wanted to provide on a final blank page. The analysis of the data collected through Parts 2 and 4 of the questionnaire consisted of a priori thematic analysis based on themes drawn from Steyn et al. (2018) alongside some added

definitions and themes specific to the analysis of the UCD Sprint (Larusdottir et al., 2019). The themes used are shown in Table 2. For this analysis, two researchers independently examined the collected data. The interrater reliability was 70%. At this point, 30% of the data were double-checked for interrater reliability, and a consensus was reached.

Table 2. Themes Used to Analyze the Qualitative Data Regarding the Course on the UCD Sprint

Theme	**Definition**
Assessment	ASSESSMENT: Assessment standards, structure, schedule, criteria and feedback.
Staff quality	WHO: Tutor and lecturer availability, teaching skills, quality and frequency of communication with participants.
Learning environment	WHERE: Quality of lecture hall equipment, the size and comfort of the course venue and the quality of the learning environment created through group project work.
Learning support	PREPARATION: Adequate preparation for assessments and the provision of additional learning support, e.g., intervention by the observers if requested by participants.
Learning resources	ADDITIONAL: The provision of additional resources and the quality, timeliness and affordability of resources provided.
Teaching methods	HOW: How the participants learn, i.e., the format of activities on the course.
Course content	WHAT: The material presented to the participants.
Course administration	SET UP: Practical arrangements such as team formation and practical course information
Course structure	WHEN: Structure and scheduling of the course activities and days when the learning activities take place
Soft skills	SKILLS acquired by participants: Critical thinking, problem-solving, leadership and responsibility, communication, and collaboration (e.g., teamwork)
People	RELATIONSHIPS: Personal relationships, selection of people for the course
Overall experiences	OVERALL EXPERIENCES: Overall course experience, level of motivation, atmosphere, free time activities, lunch and snacks, accommodations

4.3.2 Results Regarding the Usefulness of the UCD Sprint

The quantitative results of Part 3 of the questionnaire, i.e., the participants' ratings of the usefulness of the UCD Sprint activities, are shown in Table 3.

Table 3: Participants' ratings of the usefulness of the steps involved in the UCD process (RQ2)

	Was it thought-provoking?	Was it useful for the course?	Will you use it in your job/education ?
Initial mapping	5.46	5.92	5.46
User group analysis	5.36	6.00	5.14
UX goals	5.50	5.79	5.50
Interviewing users	5.36	5.71	5.14
Refining map/Selecting a target	**5.00**	5.64	5.00
Exploring webs from users	5.21	**5.36**	**4.79**
Defining users' tasks	5.50	6.07	5.21
Brainstorming ideas (Crazy 8)	6.00	5.93	5.21
Design solutions	5.71	5.79	5.43
Low-fi prototyping	6.15	6.21	5.50
User testing low-fi prototype	5.50	6.07	4.86
Realistic clickable prototype	6.07	6.21	5.79
User testing realistic prototype	6.07	6.36	5.36
Analyzing testing results	**6.23**	**6.38**	**5.85**

Highest score	6.23	6.38	5.85
Lowest score	5.00	5.36	4.79

* The numbers in bold are the highest and lowest in each column

The activity with the highest score in terms of being thought-provoking, useful for the course, and useful for the future was the analysis of the results of the user testing. Other steps, such as low- and high-fidelity prototyping and user testing of high-fidelity prototypes, also received high scores. The user testing of high-fidelity prototypes was conducted with users who were not involved in the course, and each session lasted for 30 minutes. After each user testing session, post-it notes containing notes and important points drawn from the user testing were put on the blackboard in line with the appropriate task. Gradually, a visualization of the results emerged. The activities that received the lowest scores from the participants with regard to thought-provoking were refining the map and selecting a target for making the prototypes. The activity that received the lowest

score from the participants with regard to being useful for the course and the future was examining the webs suggested by the users.

To answer RQ3, we collected data from participants regarding the positive and negative aspects of the course. We received 66 comments in total in Parts 2 and 4 of the questionnaire. Small sample sizes precluded detailed statistical analysis. That fact notwithstanding, the comments were generally positive. Specifically, the data included 50 (76%) positive comments and 16 (24%) negative comments; thus, the comments were quite positive overall. The comments were analyzed based on the themes described in 4.3.1, and the results are shown in Table 4.

Table 4: Positive and negative aspects of the course according to participants

	Positive	**%**	**Negative**	**%**
Soft skills	11	22%		
Course content	10	20%	1	6%
Teaching methods	8	16%	2	13%
Experience	7	14%	1	6%
Course structure	6	12%	10	63%
Staff quality	3	6%		
People	2	4%		
Assessment	1	2%		
Learning environment	1	2%		
Course administration	1	2%	1	6%
Learning support				
Learning resources			1	6%
Total	50	76%	16	24%

The positive comments clustered mainly into five themes that covered 84% of the comments in total. These themes included soft skills, course content, teaching methods, experience, and course structure. Two examples of positive comments on soft skills were “a new way of thinking and working” and “working in a team.” These comments were classified as positive since the participants gave these comments when they were asked

about what aspects of the course were good. The comments in the course content category were more closely related to the UCD Sprint process itself. Participants appreciated "gathering more info from users," "designing on paper" and "repetitive user testing." Examples of comments on teaching methods included "You learn by doing" and "The course is practical." Two examples of the experience theme were "the overall organization" and "the human touch."

In terms of negative comments, the dominant theme was the course structure, covering 10 out of the 16 negative comments. Examples of negative comments in that category included "5 days instead of 4 was going to be more ideal"; "too many breaks"; and "insufficient time to build a prototype."

Overall, the participants praised the way in which the course encouraged cooperation, interactivity, and theory-exercise iteration. The participants praised the activities involving users, primarily user testing. With regard to negative feedback, time constraints, especially when asked to deliver a prototype, were often mentioned. Moreover, the participants expressed a desire for more time for exploration and more in-depth tool guidance regarding software such as Figma[3] (the tool used in the course for rapid prototyping). While they appreciated the time spent on and focus placed on becoming familiar with the users, once they had started to understand the users, they occasionally found the allocated task time to be insufficient.

4.4 Part 3: Future Implementation of the UCD Sprint

This last part of the study addressed *RQ4: How do practitioners envision the future implementation of the UCD Sprint process in their design approaches?* In particular, we were interested in how participants perceived the course on UCD Sprint several weeks

[3] https://www.figma.com/

after the course, their possible application of the process in the context of their practical projects, and the potential for employing the UCD Sprint to understand user needs. Thus, seven weeks after the course, specifically from June 21 - July 14, 2022, follow-up semi-structured interviews were conducted.

4.4.1 Participants, Data Gathering and Data Analysis

A total of 8 of 14 course participants were interviewed. We selected course participants who were available at the time of the interviews. Specifically, 4 interviewees were full-time employees working at IT companies as designers/developers, 3 interviewees were working part-time at IT companies as designers/developers while pursuing their PhDs in Computer Science (industrial PhDs), and 1 was a freelancer with a background and a strong interest in UCD who was pursuing studies in Computer Science. In the usual manner, interviewees signed a digital consent form informing them about the collection of audio recordings and the management of sensitive data. Participants were not given any remuneration or reward for participating in this study.

The follow-up interview was structured in 4 sections. The first section focused on current projects on which the interviewee was working at the time of the interview. The second section collected data on the course the interviewee had attended, namely, the interviewee's opinions, feelings, and experiences with using the UCD Sprint during the course. In the third section, we first investigated whether the interviewee had already had the opportunity to use the UCD Sprint in ongoing projects. If the answer to this question was yes, we asked whether the whole process or only some steps were applied and requested further details regarding this application. We primarily investigated whether the interviewee would like to apply the UCD Sprint process in the future and how he or she would promote its adoption by the management team. The fourth section focused on

the interviewee's opinion regarding whether using the UCD Sprint is instrumental for focusing on user needs appropriately and on the specific methods involved in the process that are the most important for this goal.

Two researchers were involved in each interview: one researcher served as the interviewer, and the other interviewer assisted by taking notes. The interviews were audio-recorded. Each interview was transcribed before analysis. An inductive thematic analysis of the collected data was performed. Two researchers independently examined the interview transcripts and analyzed them in terms of themes. The interrater consistency was 70%. The remaining 30% of the results were discussed until consensus was reached.

4.4.2 Results Regarding Future Implementation of the UCD Sprint

Table 5 shows the identified themes, their definition and the main results that emerged from the analysis.

Table 5: Themes, their definitions and main results

Theme	Definition	Main results
Process	Overall opinions, feelings, and experiences pertaining to the UCD Sprint process and its use in a company	● UCD Sprint is viewed as suitable for companies that create software systems. ● The methods used are effective and resource-saving. ● This approach requires the involvement of the main stakeholders, including end users. ● The tests are essential for evaluating the quality of the prototype. ● The paper-based low-fidelity prototype could be substituted with a digital low-fidelity prototype. ● The discovery phase is not feasible because it resembles retracing what has already been approved by the customer.
Course	Overall opinions, feelings, and experiences regarding the UCD Sprint course	● The course structure is didactically effective. ● The phases are well organized and defined in terms of time. ● The multidisciplinarity of the course group is positive.
Use in Practical Projects	Experiences regarding the use of the UCD Sprint in their current projects or future ones.	● Some practitioners are now performing user testing; in general, they do not yet employ the complete UCD Sprint.

Theme	Definition	Main results
		● One practitioner created digital prototypes for the interface of a product and tested them.
Understanding of Users' Needs	The potential of the process or some of the methods proposed to collect data concerning user needs	● Users' involvement in the design process is important. ● The interview is very useful for collecting users' needs. ● User tests allow users' needs that are not identified by the customer to be collected.

Process. This theme concerns the overall opinions, feelings, and experiences of the interviewees with regard to the UCD Sprint process. Participants considered the process to be useful for companies; they appreciated the methods it involves and, reflecting on such methods in the weeks after the course, they believed that they are useful for supporting the design of usable products that are able to create a positive UX. As one interviewee explicitly stated, "*The process is valuable because it uses effective methods that are resource-saving*" (Full-time designer/developer). Another interviewee claimed that *"The methods it [UCD Sprint] uses involve important stakeholders"* (Freelancer). Two interviewees noted that *"The UCD Sprint involves the whole team, not just the developers as is done in the company"* (Part-time designer/developer) and *"Working in a team, members understand why one makes a decision. Working together means getting to a goal together"* (Full-time designer/developer). One interviewee noted that managers still need to change their way of thinking to foster the use of UCD Sprint. This opinion was also expressed by others; two interviewees working in the same company noted that, after the course, they organized a seminar for their colleagues in which they reported their experiences at the course and explained the value of the UCD Sprint. Many people attended the seminar, including managers, developers, and analysts. The main message they wanted to convey is that the application of UC methods is not a waste of time; in

contrast, as explicitly reported in the interviews by one of these interviewees, *"It is an investment and offers economic benefits to the customer. It is a starting point. Such methods are not commonly used. There is a need for them in the company!" (*Full-time designer/developer*)*

Interviewees greatly appreciated the user tests. As one participant claimed, *"The two user tests ensure the development of a truly quality product"* (Part-time designer/developer). As another interviewee stated, *"Evaluating both paper and digital prototypes are very important steps. The former permits us to verify that the identified features are those that the user needs. The latter allows us to refine the features."* (Freelancer). However, half of the interviewees noted that the low-fidelity paper prototypes could be eliminated while still performing two user tests. They observed that with current prototyping tools, an interactive low-fidelity prototype can be created very quickly, which can then be evaluated through a user test. The successive high-fidelity prototype can also be evaluated through a user test. One interviewee noted that *"We prefer to develop a rudimentary prototype that is a digital one because the user needs to click!"* (Full-time designer/developer).

Course. The second theme pertaining to the UCD Sprint course attended by the interviewees refers to the overall opinions, feelings, and experiences of the interviewees with regard to the course from a didactic point of view. The thematic analysis of the answers highlighted the fact that the participants appreciated the course highly and found it to be very interesting, as it allowed them to broaden their work background. One key positive aspect that all interviewees mentioned is that the course structure is didactically effective, alternating between theory and practice and thus allowing participants to apply the proposed techniques. As one interviewee noted*, "The course was not heavy at all!"* (Part-time designer/developer). In addition, two interviewees

indicated that they appreciated the course structure, which allowed them to test a prototype immediately. Another interviewee noted that *"You learn to apply the process very easily!"* (Full-time designer/developer). As still another interviewee indicated, *"It was a wonderful experience, a course that was different from those suggested by my company"* (Full-time designer/developer). She explained that, generally, company courses are less practical, and participants are more passive. Another interesting aspect of the course was the multidisciplinary nature of the group (for example, *"I truly enjoyed the multidisciplinary nature of the group"* (Part-time designer/developer) and *"Multidisciplinarity of the team is crucial for the success of the product"* (Part-time designer/developer)). This multidisciplinarity allowed group members to exchange experiences and knowledge: *"Comparing the ideas of people with different backgrounds helps a lot when defining new ideas."* (Full-time designer/developer)

Use in Practical Projects. Regarding this theme, 6 of 8 interviewees had no way to apply any methods used in the UCD Sprint because they were working on projects that were already at an advanced stage of development. However, all interviewees claimed that they would gladly apply the whole process. Only two interviewees were performing user tests. In particular, one of these interviewees noted that *“I’m working on a project that is already in progress. I have performed two user tests on digital prototypes of the user interface I created”* (Full-time designer/developer). She involved four colleagues who worked in the same company as back-end developers and who acted as end users. She asked participants what they thought about the interface, what happened if they clicked on some buttons, and what could be improved. As she reported, *"I received some useful comments. For example, participants thought they were getting to one output while instead the button took them to another, so I added intermediate steps"* (Full-time designer/developer). She refined her prototypes based on

the comments she received and then asked her colleagues to review them once again. Indeed, she claimed that one evaluation was insufficient and that at least one iteration is necessary. She added the following: *"Rather than getting to the finished product and not liking it, perform intermediate evaluations and get to a better final product."*

Understanding of Users' Needs. This final theme refers to whether the overall approach or, at least, some of the proposed methods were perceived as useful with regard to collecting data concerning user needs. As one interviewee said, *"The course allowed me to better understand the importance of involving users in a system design process as well as the need for iteration, which was especially evident in the final part of the approach with the execution of two user tests"* (Full-time designer/developer). Several interviewees claimed that the interview was important because it provides a good understanding of users' needs. However, it is often the case that the company develops the same type of product. In this case, interviews are not essential because the requirements are defined based on the knowledge gained by the company's employees from their previous experiences. Evaluations of the low-fidelity and high-fidelity prototypes facilitate the identification of further user needs for that specific project.

5 Discussion

In this section, we consider the three parts of the study reported in Section 4 and discuss the main findings, as well as their implications and/or contributions.

5.1 Current Ways of Working

In the first part of the study, practitioners working in IT companies were interviewed to understand their current design process and the extent to which they involve users. For many years, researchers have acknowledged that involving users in the software development process positively impacts the quality of the product and enhances user

satisfaction (e.g., (Kujala et al., 2003), (Bano & Zowgly, 2015)). Nevertheless, practitioners are very often reluctant to perform user research primarily because they think that the available methods are very resource-demanding and that no methods suitable for companies' needs are available (see, e.g., (Ardito et al., 2014; Katsini et al., 2016; Teka et al., 2017)). A more recent study by (Inal et al., 2020) specifically involved UX professionals; even if more than 70% of such professionals claimed that they employ a UCD approach to develop their product, they complain about the obstacles they face when conducting user research due to a lack of support by the company's top management, which still neglects the importance of UX.

The interviewees in our study were not UX professionals who appreciate user research and UCD approaches; rather, they were practitioners involved in the design of interactive software. Their answers indicated that their current design processes had not changed from the approach reported in previous studies, e.g., (Ardito et al., 2014), which generally neglects user research. These interviews were thus instrumental to show that it is necessary to teach practitioners new processes that focus on user research.

In the companies at which our respondents work, users are not generally involved in the design of software products. In some cases, users are consulted only during the pre-go-live and go-live phases, when a stable version of the developed product is released. However, it is well known that at this stage of software development, it could be too late to correct any serious errors that might impact the software product's usability and the corresponding UX. These late changes could also be costly. Thus, the false belief that user involvement is time-consuming and ineffective remains.

All interviewees said that they work in companies that employ agile processesThey reported that the only stakeholder involved in the process is the customer, who plays the role of the user both in the initial phases of the process with regard to illustrating the users' needs and in the activities associated with prototype evaluation. Our interviewees argued that it is the customer who pays for the software product being developed and thus that they needed to comply with the requirements indicated by the customer, who accepts and signs the document containing the specified requirements that developers must consider in their work. Similar results have been reported by (Bruun et al., 2018) and (Persson et al., 2022), who claimed that users are involved only during the initial phases of software design, whereas during the development phase, the software is assessed by members of the development team, who often lack usability and UX skills.

Interviewees claimed that they generally do not produce paper prototypes; in their company, some designers create prototypes using PowerPoint or more professional tools such as Figma and Balsamiq. Only one company manager indicated that this company creates a prototype when the requirements are difficult to describe; thus, the prototype is valuable simply to verify whether the team understood the customer's requests. This finding is in line with the results reported by (Cajander et al., 2013; Bruun et al., 2018), according to which UX specialists made wireframe prototypes to verify with the development team or the chief technical officer whether the design was possible to implement in a cost-effective manner.

5.2 The Usefulness of the UCD Sprint Process

In the second part of the study, practitioners were invited to attend a course that enabled them to practice using the UCD Sprint process. Two previous studies on the UCD Sprint process used during two-week courses in 2018 and 2019 that involved students in higher

education were conducted (Larusdottir et al., 2019; Roto et al., 2021). The first study showed that the activities of sketching and storyboarding were highly rated (Larusdottir et al, 2019). In both studies, high-fidelity prototypes received a high ranking, while in the latter study, the evaluation of such prototypes with users was rated highly (Roto et al, 2021).

In the study described in this paper, the activities that received a high rating with regard to being useful were low-fidelity prototyping, high-fidelity prototyping, user testing of high-fidelity prototypes and the analysis of the test results. Notably, our participants claimed that they were not used to making prototypes, so for some of them, this represented a new activity that they found useful. This is a great contribution of our study, it indicates that the practice of the UCD Sprint can convince the practitioners of the importance of performing activites, such as prototyping, that are fundamental for designing useful and usable software (see, e.g., [rif. a libro su prototyping, chiedere a Paolo]). Actually, the participants called for more time and more in-depth tool guidance regarding Figma[4], the tool used in the course for rapid prototyping, because they greatly appreciated the support of this software in the creation of prototypes at different levels. Due to their lack of familiarity with the creation of such prototypes, participants required more time for these activities, which was one reason they complained about the structure of the course; they would prefer a course that lasted an additional day, i.e., a total of 5 days instead of 4. These results are in line with the results drawn from the previous courses. In particular, high-fidelity prototyping was valued highly in both previous courses attended by university students. The results regarding the high ranking of user testing of high-fidelity prototypes in this paper are in line with the results previously reported by Inal et al. (2020), who indicated that user testing was the most

[4] https://www.figma.com/

frequently used method. The value of informal user testing with the thinking-aloud protocol has been well known since the seminal book by Nielsen (1993); this method is highly appreciated and used widely, especially in formative evaluation or in situations in which resources are limited or evaluators are less experienced. Such informal user testing is currently widely used in the website evaluation protocols adopted by several Italian public administration institutions (see, e.g., (Federici et al., 2019; Federici et al., 2021)).

The activities that received the lowest scores from the participants with regard to being thought-provoking were refining the map and selecting a target. This finding is understandable since the initial mapping had already been accomplished in Step 1, and now the participants were asked to revisit the map after conducting interviews with the goal of reflecting on how the map should be changed. The activity that received the lowest score with regard to being useful in the course as well as in the future was examining the webs suggested by the users. The participants did not have much time to accomplish this activity since other steps took longer than expected; thus, it is unsurprising that they believed that this step was not particularly useful.

In our study and in both studies on previous courses, the participants were asked to provide their impressions of the course itself. The course structure was the most frequently mentioned aspect in our results, receiving the highest frequency of negative comments, most of which remarked that the pace was too fast and that the participants were not given sufficient time to complete the homework of conducting interviews and developing prototypes. However, the feedback revealed that, in general, the course structure was suitable for practitioners. The participants' consensus regarding the successful nature of the course alongside the interest they expressed in including this

course as part of company training programs or as part of their education in general indicate an encouraging step toward similar attempts in the future.

5.3 Future Implementation of the UCD Sprint

The objective of the third part of the study was to investigate whether and how practitioners would modify their traditional design practices to include some of the activities proposed by the UCD Sprint. We were specifically interested in collecting information regarding the participants' willingness to involve users and apply UCD Sprint in their design processes. We also wanted to know what they thought about the course after some time had passed.

The participants were convinced that the UCD Sprint should be applied to the task of designing software in their IT companies, but they had not yet applied it to their ongoing projects. Some practitioners indicated their willingness to perform user tests. One practitioner reported performing two user tests involving her colleagues, who acted as final users. She was happy to discover problems that she would not have identified without the involvement of users.

Involving users in the design process was highlighted as positive by two other practitioners. They appreciated the course highly and organized a seminar at their company one week after the course to demonstrate the importance of user involvement. People with different roles in the company, ranging from managers to developers, attended the seminar and appreciated the user-based cost-effective process provided by the UCD Sprint.

The practitioners found the reality check phase to be important and highlighted that the user test results are indeed useful for refining user requirements. They also emphasized the fact that what is not identified by customers is undoubtedly discovered

during user tests because observing users' interactions with a system prototype can easily reveal the product's shortcomings.

Surprisingly, some practitioners claimed that the interviews with users during the discovery phase could be eliminated. They clarified that requirements are defined and approved by the customer at the beginning of the design process in their companies. Thus, it is useless to conduct interviews without having the possibility of modifying the identified requirements. Participants were convinced of the value of user interviews with regard to collecting important information from users, but unfortunately, the current practice imposed by top management required only customer involvement. Some participants doubted the significance of paper prototyping but confirmed the importance of performing prototype testing twice with users during the sprint. They indicated that designing digital low-fidelity prototypes would be more straightforward in IT companies. This finding stands in contrast to the results of previous research that has highlighted the advantages of an initial paper prototype (Snyder, 2003; Snyder, 2007).

All practitioners appreciated the course content and structure. The main difference between this course and other courses proposed by their companies was that they could more readily apply the techniques the approach suggests in this context. The course enabled them to "experience first-hand" the real potential of the user-based process and to appreciate the reduced resources required for user involvement. The practitioners explicitly noted that user involvement was not as costly as they had believed and that it is instrumental in the design of systems that offer a good user experience.

6 Limitations of the Study

In this section, we address the limitations of the performed study by discussing some issues that may have threatened the internal and external validity of our study (Lazar et al., 2017). We also report how we mitigated the most critical issues regarding the three parts of the study.

Internal validity refers to the extent to which one can be confident that a cause-and-effect relationship established in a study cannot be explained by other factors. It can be threatened by various hidden factors that can compromise the achieved results, as discussed in the following.

Subject Experience. We involved practitioners from companies with different roles, and the companies thus selected were of different sizes. The companies operate in the area around Bari. We plan to perform other interviews involving practitioners from different countries. For Part 2, the subject experience threat was alleviated because none of the subjects had any experience with the UCD Sprint process.

Method Authorship. We eliminated the biases entailed by different interviewers since the same person interviewed the participants to avoid possible incoherence the conduct of interviews in Parts 1 and 3. Regarding Part 2, we addressed the possibility of bias resulting from different course teachers the same teacher was responsible for every course session. In this way, we avoided any variability in training.

Intelligibility of the Material. For Parts 1 and 3, the questions of the two interviews were validated by three authors, who are also software designers, to verify their intelligibility. For Part 2, the course, which featured a different structure, but which involved the same activities, had already been held three other times, thus enabling us to guarantee the correctness of its structures and the materials available to the participants.

Available Time. This issue pertains only to Part 2. Course participants had limited time to complete the process activities and their homework; however, they were aware of the fact that they were participating in a didactic course and that the course's main goal was to illustrate the activities that the UCD Sprint proposes. We constrained the time available to participants to avoid overloading them with excessive work that could encourage them to downgrade their performance and perceptions, thus leading to useless results.

The external validity of a study refers to the possible approximation of the truth of its conclusions to generalize the study's results to different contexts. In this respect, the main threats to our study are the following.

Sampling Bias. The size, complexity and time-criticality of participants' projects limited the validity of the study. In addition, the participants were people working in different companies in southern Italy. Thus, they represent only a small section of the entire population. We plan to perform other studies involving people from different countries and more companies of different sizes, as part of which we will ask them to practice the UCD Sprint on projects on which they are working.

Situation Effect. This issue pertains only to Part 2. The course was held in a lecture room of a university department that is similar to any lecture room that can be used in a company. Thus, this environment should not create any problems. However, the members of each group were drawn from different companies, and the case study on which they worked was not an actual project of any member. We are in contact with companies to organize future courses in which participants can use the UCD Sprint to support a company project.

Testing Effect. Part 2 of the study involved only one group of practitioners who attended the course. No baseline or control group was considered. We plan to perform a

comparative study to obtain further insights into whether the UCD Sprint process increases awareness of the importance of user involvement and whether it could be successfully adopted by companies to enhance the innovativeness of their design practices.

7 Conclusion

The UCD Sprint discussed in this article is a step-by-step and cost-effective process that is based on user involvement in the early stages of software design and that aims to enhance our understanding of users' needs. This process originated from experiences in intensive courses with university students (Larusdottir et al., 2018; Larusdottir et al. 2019; Roto et al., 2021). One motivation for our research is to promote user involvement and UCD activities in the design processes of software companies since they are key elements in the creation of systems that are capable of meeting users' needs. Since the UCD Sprint process received positive feedback from university students (Visescu et al., 2023), we wanted to explore whether and how it is suitable for practitioners with regard to software design. Thus, we performed the study reported in this paper, which was conducted according to a research methodology featuring three parts.

Our overall research question focused on whether the UCD sprint is a valuable process for emphasizing and involving users in practitioners' software design practices. The results of the study show that participants were impressed by the activities involving users, particularly the user test; they appreciated that even quick and informal tests with users are capable of highlighting many problems that can be easily solved in the initial designs. We were slightly surprised that the interviews with users that aimed to collect user requirements were not as well received by the practitioners. We asked them to clarify this point, and they indicated that the current practices imposed by the

top management of their company require the customer to define requirements at the beginning of the design process and to accept and sign a document containing the specified requirements. Thus, even if participants are convinced of the value of user interviews for collecting important information from users, they have not yet performed interviews in their current practices.

The study was the first to involve practitioners. We discussed its limitations and how we plan to address these issues in future studies. More specifically, we will perform interviews and organize other courses for practitioners from various companies and countries. We are also planning to conduct comparative studies to obtain more results regarding the value of the UCD Sprint process.

The theoretical value of the UCD model, as has also been reported in (ISO, 2020), has been well known and acknowledged since the late 1980s. The work reported in this article contributes primarily to the practice of UCD. It has been shown that the UCD Sprint is a fast process that incorporates a focus on users into design practices; it involves UCD activities involving users, which practitioners valued highly. By using the UCD Sprint process, the practitioners obtained a structured and fast way of working toward the goal of creating products with a good UX.

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[Other text removed because of anonymity]

9 Authors' Contributions

Author 1, *Author 2, Author 4* and *Author 5* conceptualized the idea of studying the UCD Sprint in practice in IT companies and designed the study. *Author 1* restructured the UCD Sprint process and reorganized the course accordingly. *Author 1* prepared the didactic material and led all the classes; the other authors participated in the course as observers and guided students' teamwork. *Author 2* conducted the interviews (in Italian) with the assistance of *Author 1* and *Author 3*. *Author 2* and *Author 3* analyzed the data collected through Parts 1 and 3 of the study; *Author 1 and Author 4* analyzed the data collected through Part 2. All authors discussed the collected data and contributed to the writing and revision of the article.

10 Authors' Biographies

Marta Larusdottir is a Professor at the Department of Computer Science at Reykjavik University. Marta has researched user-centred design (UCD) activities, especially the integration of UCD activities into agile processes in the software industry. Recently, Marta has suggested new methods and processes for extending the focus on UCD activities in the context of software design.

Rosa Lanzilotti is an Associate Professor of HCI at the Department of Computer Science of the University of Bari. She promotes usability and UX practices in software development processes in industry and public institutions. She has coordinated projects aimed at developing eGLU Box PA, a web platform used by staff of Italian institutions to evaluate the usability of their websites.

Antonio Piccinno is an Associate Professor at the Department of Computer Science of the University of Bari. His research interests specifically focus on Human-Centered Design (HCD) and End-User Development (EUD). He promotes the Interplay between Human-Computer Interaction and Software Engineering and, more recently, Secure Software Analysis and Design.

Ioana Visescu is a PhD student in the Department of Computer Science at Reykjavik University under the supervision of Dr. Marta Larusdottir. With a background in business and technology and an interest in user experience, her research focuses on design sprints and design methodologies and their applications in academia and practice.

Maria Francesca Costabile is a Professor at the Department of Computer Science of the University of Bari. She was a pioneer of HCI in Italy with a focus on Human-Centered Design and usability, and in the 1990s, she promoted the Italian Chapter of ACM SIGCHI. In 2018, she received the *ACM SIGCHI Lifetime Service Award*.

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