Journal of Theoretical and Applied Information Technology
31st December 2023. Vol.101. No 24

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

EXPLORING PRIORITY OF UCD IN AN AGILE DEVELOPMENT ENVIRONMENT: A CASE STUDY IN IRAQ

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ABSTRACT

User-Centred Design (UCD) and agile software development share common values, such as customer satisfaction, continuous improvement, and flexibility. However, integrating UCD into agile software development poses several challenges that must be addressed to achieve successful outcomes. This paper investigates the existing practices of UCD, which are carried out in an actual development environment. It also explores the obstacles that software development team members may face while applying UCD practices alongside agile development activities. The qualitative and quantitative approaches are used to collect the primary data from the practitioners in different job positions. Two methods are used to gather primary data: semi-structured interviews and closed-ended surveys. The results reveal a growing realization of the usability concept in software development among Iraqi agile practitioners. Further, the results provide insight into how well they can incorporate UCD activities within agile development circumstances.
Keywords: *User-Centred Design (Ucd), Usability, Usability Engineering, Agile Development Process*

1. INTRODUCTION

Agile methodologies have revolutionized software development by emphasizing collaboration, flexibility, and responsiveness [1]. They are defined as a collection of procedures applied to increase the efficiency of the development process and produce software that meets customers' needs and expectations [2]. However, one of the critical defiance of agile methodology is that usability issues often take a backseat to other priorities, such as functionality and speed [3]. This exacting can lead to producing software products or services that are difficult to use, frustrating for users, and ultimately unsuccessful [4].

User-Centered Design (UCD) is defined as a philosophy that focuses on understanding users' needs and preferences and designing products that meet those needs [5]. Besides integrating UCD practices into agile process, usability issues could be identified early in the development process, and practitioners can refine the design iteratively based on user feedback. This integration is based on methods such as interviews, surveys, and usability testing methods, where usability requirements should incorporate into the development process, just like other requirements within the product backlog [6]. And thus, usability matters will be prioritized and addressed throughout the development process to outcome software that is functional, easy to use, and attractive to users.

In this paper, the authors carried out a survey and interviews based on a thematic framework with practitioners from software development companies in Iraq. The investigation covers existing practices that are used for covering usability issues. Also, it explores the obstacles that may hinder applying the UCD activities within the agile development process.

2. BACKGROUND

This section covers some background related to agile development and the integration of UCD activities into the agile development process.

2.1 Agile Development Method

Agile methods enable additional elicitation flexibility and managing requirements than traditional software development for quickly reacting to changes to achieve customer expectations [7]. In-person communication and recurrent feedback are the fundamental principles used in the

agile process to bring the customer's perspective to the development team [8]. These procedures support adapting specifications according to the customer's needs and perceptions during the development cycle. The software requirements are collected incrementally throughout development rather than concentrated one step ahead [9]. Agile methods usually adopt more straightforward techniques than written specifications for creating extensive requirements documents [10]. For example, "Continuous Deployment" is a distinctively agile technique that shortens the time between the production of code and the use of it by actual end users and helps cover some usability aspects [15]. The "Continuous Deployment" strategy depends on a system that automates integrating new code into the operational application. It is advantageous to release new code to the customer often to address usability issues so that user needs can be anticipated early. Another example, user stories are part of an agile Scrum software method that relies on incremental development. They are artifacts that help to shift the focus from writing about requirements to discussing them and defining requirements at a high level (see Figure 1).

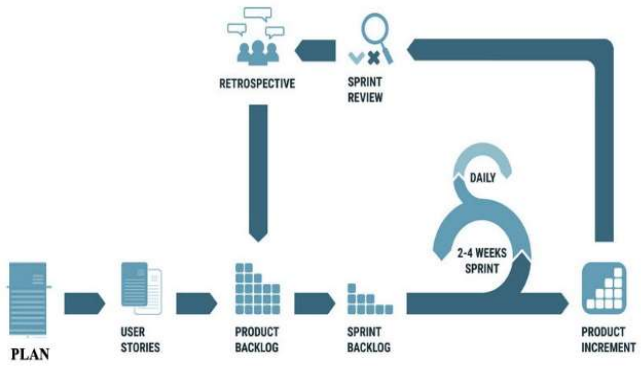

Figure 1: Scrum Software Methods

The emphasis on the working part of the software may neglect usability issues since the agile approach prioritizes delivering software more quickly and making process sprints in small cycles to provide software that satisfies customers over time [11]. The customer may have conflicting ideas related to what the software product/service should be compared to the actual user. Additionally, the concept of user interface engineering is almost absent in agile methodology [12]. Systematic activities from usability engineering were found to enhance the product's usability that are not employed during agile development. The researchers and experts sought to overcome usability barriers in regular development by adapting the agile approach [13, 14]. By modifying agile approaches, development companies can realize the benefits without the side effects. However, the outcome of the adaptation approach does not yet settle the conflict toward the quality of user experience. Especially with agile methods overwhelmingly rely on close collaboration and communication between members of the development team and stakeholders. And despite this can be fruitful for gaining feedback and doing immediate adjustments, it may not always allow for in-depth usability activities and refinement. Usability activities require time and a structured approach to collecting and analyzing feedback from actual users, which may not always conform to the agile development nature.

2.2 UCD practices

UCD is an iterative process, designers use a mixture of investigative methods and tools to represent end users' viewpoints and come up with feedback help development practitioners in developing usable and useful software. The UCD principles stem from designing for the user leads to better outcomes. Designers may create software products that are personalized to the demands of consumers by studying their goals and preferences and thus increase user satisfaction and adoption [27].

However, in the agile software development process, some obstacles limit this activity's complete, effective and efficient integration even though usability features are considered significant for developing usable software systems [27].

These obstacles represent that many professionals have had to expand delineations for UCD practices within the agile process adopted by their software development organizations [28]. Moreover, this requires adaptation of the UCD techniques since most of these techniques require time to implement and resources that an agile process can only afford

with adaptability. Over and above that, agile methodologies do not provide any guidelines for supporting the integration of UCD principles and practices in the agile process. Furthermore, it seems to be unwanting. Where agile methodologies concern with software functionality rather than placing focus on usability issues.

The principles of UCD [24] incorporate the term user (use or usability). Focusing on the agile approach aims, finding the end-user, and handling the usability issues are more complicated. Despite all, the agile aim is to focus on customer collaboration. The customer should be involved as a team member, categorize and organize the stories, and analyze the software. Many cases have been reported in which the people who enroll as part of agile customers are not genuine end-users, such as [11, 13, 17]. In a case study by Jeff Patton, which states that "Hitting the Target: Adding Interaction Design to Agile Software Development" [25] his team delivered high-quality software quickly when using agile methods alone. Apart from this, the software did not thrill and satisfy the end-user; it just limited the user in performing or completing their daily work routine.

There are critical points that the agile process and UCD do not have in common and stem from the truth that the key tent activities of each approach are different. As discussed by [9], he stated "Usability activities focus on how the end users will work with the software whereas agile development focuses on how the software should be built". Nielsen claims that "Agile´s biggest threat to system quality is the fact that it's a method proposed by programmers and mainly addresses the implementation side of system development" [16]. Other researchers have likewise consented to improve the quality of the produced software, we need to pay much attention to usability and UCD with agile methodologies [17-21].

Many studies from the literature [15-17, 27] have explored the association between UCD and agile principles and how users can be a central part of the development process. However, most of those studies focused on technical aspects in the operational area, which results in customized methods, and techniques or proposed specific approaches. As far as the authors know, a survey study that highlights incorporating UCD activities into agile methods in the context of Iraq companies has yet to be carried out. Yet, the developers and usability engineers dealing with agile methods throughout work together to impact the improved quality of the software services and products, but studies must highlight this incorporation. In that, a survey is needed to close this gap. The main goal of this paper is to investigate the existing practices of UCD, which are carried out in an actual development environment, and also, to explore the obstacles that may face agile team members while applying UCD practices alongside the development process.

Therefore, our research questions are:

1. To which extent do the agile development team members understand the usability concept and its activities?
2. What is the orientation of the development team members toward applying UCD practices in the agile development process?
3. What are the major obstacles that software development team members face while applying UCD practices alongside agile development activities?

3. RESEARCH METHODOLOGY

In this section, the authors describe the research methodology used in this study. Mixed methods are used as a methodology which is a questionnaire and interviews to get answers to research questions. Figure 2 shows the steps of the research that are followed by the authors in this paper.

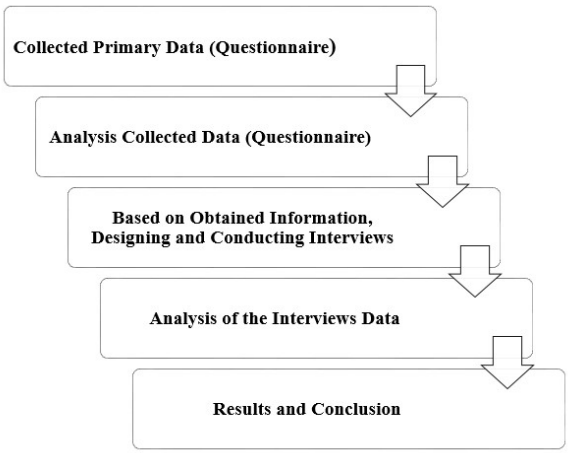

Figure 2: Research Methodology

As shown in Figure 2, five steps have been followed in this research: collecting and analyzing primary data to enhance our knowledge about applying UCD activities within the agile development process. Based on the obtained data, interviews are conducted to investigate obstacles that may hinder implementing UCD techniques effectively into agile methods throughout development.

3.1 Methods

Two types of methods were conducted to collect primary data. First, a survey with closed-ended, multiple-choice questions was developed. The closed-ended multiple-choice questions were graded on a 5-point Likert scale. There are 16 questions, covering the research questions from demographics to agile practices, UCD approaches, and the effects of combining agile methods and UCD. Five academic and professional specialists in agile usability/UCD provided feedback on the survey's readability, validity, and usefulness. The questionnaire is intended for professionals (mostly developers and usability practitioners) who work with agile methodologies that incorporate some HCI techniques. In that, at least one member of the agile development team works as a usability specialist or has some knowledge regarding UCD activities. The population size and time have been considered before determining the sample size. However, 100 participants are enough sample size for obtaining reliable feedback [29]. For this, 174 questionnaires were distributed, and finally, 150 exactly filled in questionnaires were gained after eliminating incomplete and invalid questionnaires. The survey was started in early June 2023 and was closed after four weeks. Because of the fact that the small size of sampling may lead to bias, the authors determined large enough sample size to collect data from those who filled out Google Forms from various software development organizations in Baghdad, the capital city of Iraq.

The sample size was calculated using the following assumptions: maximum variability for which p + 0.05, a precision level of 10% (e = 0.1), and a confidence level of 95% (2).

$$n = \frac{(Z^2 \times p\,(1-p))}{e}$$

Where Z = 1.96, p = 0.05, e = 0.10,

$$n = \frac{(1.96^2 \times 0.5\,(1-0.5))}{0.10^2} = 100 \text{ Samples}$$

Second, 30 interviews have been conducted with participants who are software engineers from the industry field in Baghdad, Iraq. The organizations were chosen to accord to their locations where they were close enough for the researcher to visit personally and conduct the interviews whenever availability arose. However, for convenience, the interviews in some of these cases were carried out using the Zoom application online. Another commonality between the selected organizations was that they were all small and active companies.

3.2 Method of Data Analysis

Qualitative and quantitative methods are also used in this study. For the purpose of analyzing the quantitative data to produce results free from bias and meet the necessary goal, appropriate and pertinent, statistical analysis tools were employed. Following the data collection, the following crucial actions were taken:

To enable testing questions, including demographic information are first numerically coded using an SPSS analytical tool version 24.

Secondly, the unprocessed data was input and blank responses were addressed. A questionnaire item was represented by each row, while response data was represented by each column. Analyses were used in the same data set entered in the SPSS file.

Further, a qualitative approach was used to understand how software development teams can apply UCD within their projects and to stand on crucial obstacles that may hinder these activities to produce usable and easy-to-use software for the end user.

3.3 Analysis of Reliability

To analyse the reliability of the obtained data, we applied Cronbach's alpha method to test the instrument's reliability and exploratory factor analysis method to test the instrument's validity. We measure the internal consistency reliability for all items. An acceptable value is defined as being more than 0.7 [23].

According to Table 1, "UCD practices in the agile process" is the factor with the highest Cronbach alpha. With (Cronbach alpha of 0.93), this is status as "Excellent" according to [49]. Conversely, "Understanding usability" with a (Cronbach alpha of 0.83), was the factor with the lowest. Nonetheless, every factor's value was more than 0.7, indicating its reliability.

Furthermore, by [26], the fundamental structure of every construct was determined by exploratory factor analysis employing “Varimax rotation”. The results reveal that items were loaded on the correct factor with values above 0.7, see Table 2. Convergent validity testing was also applied to test the items' correlation, according to the recommendation of [26]. The results, as indicated in Table 2, demonstrated that the constructs had strong convergent properties, with item loadings being greater than 0.7.

Table 1: Summarizes the Reliability

Sections	Cronbach Alpha	No. of Items	Reliability Status
Understanding usability	0.83	6	Good
UCD practices in the agile process	0.93	6	Excellent
Obstacles hinder applying UCD activities	0.91	6	Excellent

Table 2: Summarizes the Factor loadings

Factors	No. of Items	Items	Factor Loadings
Understanding usability	6	UU1	.881
		UU2	.796
		UU3	.813
		UU4	.987
		UU5	.738
		UU6	.898
UCD practices in the agile process	6	UCDP1	.881
		UCDP2	.870
		UCDP3	.973
		UCDP4	.738
		UCDP5	.888
		UCDP6	.883

Obstacles hinder applying UCD activities	6	OUCD1	.892
		OUCD2	.737
		OUCD3	.868
		OUCD4	.883
		OUCD5	.854
		OUCD6	.914

4. RESULTS

The results of the questionnaire survey are presented below.

4.1 Background Information

The results presented in this section accurately reflect the backgrounds of the respondents who participated in this research;

*Table 3: Age * Gender Cross-Tabulation*

Responses		Gender		Total	
		Male	Female	Frequency	percentage
Age	18 – 25 years	13	13	26	17.3
	26 – 35 years	58	18	76	50.7
	36 – 45 years	24	9	33	22
	46 Years and Above	13	2	15	10
Total		108	42	150	100

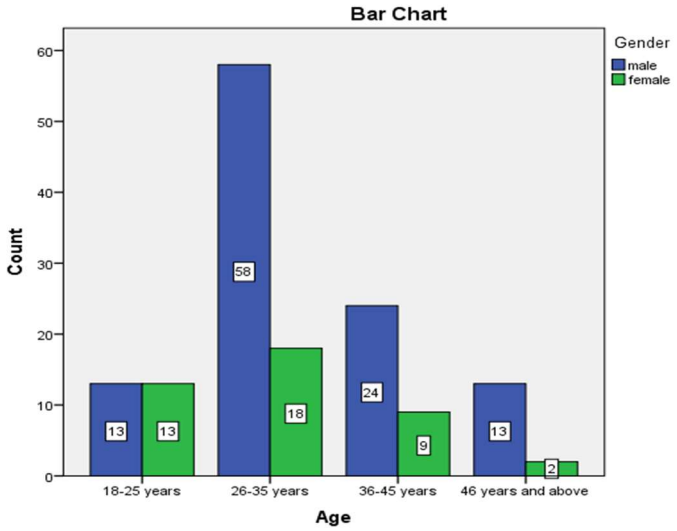

*Figure 3: Age * Gender Cross-Tabulation*

Table 3 and Figure 3 display the cross-tabulation of the age of responses with their gender. There were 150 survey participants in all, as indicated in Table 3 and of those, 108 (72%) were men and 42 (28%) were women. From the output shown, it is seen that there are 26 aged between (18 – 25 years) (13 of them are males and 13 are females), 76 aged between (26 – 35 years) (58 Males and 18 Females), 33 were

aged between (36 – 45 years) (24 Males and 9 Females), and finally 15 of the respondents their aged 46 and above most of them are (males 13 to only 2 females).

*Table 4: Job position * Years of experience*

Job position	Years of experience				Total
	< 1 year	1-3 year/s	4-10 years	> 10 years	
Manager	-	2	13	8	23
Usability engineer	4	4	-	1	9
Developer	9	24	5	3	41
Tester	-	3	18	7	28
Product owner	1	8	3	-	12
UI designer	2	17	4	-	23
Others	4	7	2	1	14
Total	20	65	45	20	150

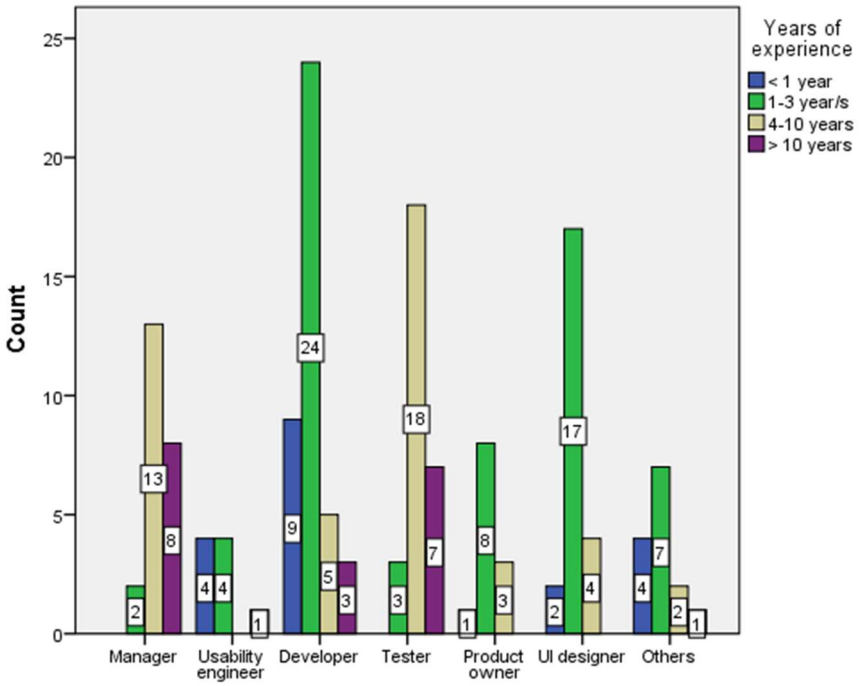

*Figure 4: Job position * Years of experience*

The title position and years of experience of the survey respondents are described in Table 4 and Figure 4. Table 4 displays also the results, which indicate that a greater proportion of the respondents fall into the 1–3 year experience range, which is 65 participants, followed by the group from (4 – 10 years) which is 45 participants. The group of (< 1 year) and (> 10 years) each represented by 20 respondents only.

4.2 Result of the Questionnaire

Table 5: Statistics of Items

Section	N	Mean	Std. Deviation
understanding usability	150	2.02	.647
practices of UCD	150	2.49	.813

Table 5 describes statistically the items of each section; it is apparent that "practices of UCD in the agile development process" is the section with the highest mean (2.49). "Understanding usability" has the lowest mean (2.02) of all the sections. However, they are all at the same level because none of the items have a mean below 3.0. We can infer from this that the respondents believe highly of the study's sections that make up the items.

Table 6: Percentage of Understanding Usability Section

Items	Understanding usability	Strongly Agree	Agree	Indifferent	Disagree	Strongly Disagree	Total
1	I understand the concept of usability	63.3	28.7	4.7	2.0	1.3	100.0
2	I follow UCD guidelines when developing the user interface of the software	8.0	8.7	28.0	44.7	10.7	100.0
3	I can design user interfaces that are achieving usability requirements	40.0	46.0	8.7	2.0	3.3	100.0
4	I can design user interfaces that are appealing to the end user	38.7	48.0	10.7	2.7	0	100.0
5	I can design user interfaces that are easy to use for the end users	41.3	37.3	17.3	2.7	1.3	100.0
6	I find UCD helped to focus on usability	44.0	42.0	9.3	3.3	1.3	100.0

According to the data displayed in table 6, the majority of replies indicate an intense level of agreement among respondents, which is a sign that they "agree" or "strongly agree" with the claims. This is exceptionally high for the section "understanding usability" items. For example, in item 1, "I find UCD helped to focus on usability", most participants believe that applying UCD activities during the development process could help capture usability requirements and achieve usable software. To which extent agile software development practitioners find that based on actual development procedures, they can design user interfaces that are usable, appealing and easy to use for end-user, the results appeal that most of the respondents indicated they agree. Agreements with the other items are likewise strong except for statement 2, where the degree of the compact is much lower. Statement 2 covers "to which extent, developers follow UCD guidelines when developing the user interface of the software," which results appear that the participants do not follow UCD guidelines because they have no enough time [4] and also they prefer to choose alternative design solutions because they found them to be better than the one mandated by the guidelines [6]. In general, the results show a strong level of agreement for most items. Thus, the respondents regard the components of the study that make up applying UCD activities in a development organization as necessary.

Table 7: Percentage of Understanding usability section

Items	UCD practices in the agile process	Strongly Agree	Agree	Indifferent	Disagree	Strongly Disagree	Total
1	I find UCD practices are important to produce usable software	68.7	18.7	8.7	2.0	2.0	100.0
2	I employ end-user feedback to promote the aspects of usability of the software products	55.3	32.0	10.0	1.3	1.3	100.0
3	I find that there is enough time to apply UCD activities within the agile process	0	20.7	40.0	24.0	15.3	100.0
4	I find the nature of agile methods is suitable to apply UCD activities effectively	14.0	34.0	22.7	29.3	0	100.0
5	I find the nature of agile methods is suitable to apply UCD activities efficiency	9.3	50.0	12.0	20.7	8.0	100.0
6	I apply UCD activities alongside the development process	5.3	20.0	38.0	34.0	12.7	100.0

Regarding the section "UCD practices in agile process", the results presented in Table 7, The usability in terms of "UCD practices are important to produce usable software" indicates a high percentage of agree to strongly agree responses, followed by "employing end-user feedback to improve the usability of the software products" which also shows a high level of agree. It is slightly fewer than item 1. The responses also show that item 4 and item 5 have an average percentage of acceptance which is less than item 1 and item 2. Among all terms, the lowest one is item 3, which has 60 percent acceptance, and then item 6, which has 62 percent acceptance.

In conclusion, most of the terms have a low level of acceptance compared to the understanding usability section. And this brings to mind that development practitioners believe in UCD philosophy as an essential part of the development process, which can help in understanding the needs and goals of users. Still, in contrast, some practical constraints or obstacles hinder integrating UCD activities hand-in-hand throughout the development process. In the next step of this research, the authors will interview the software development members to identify the recent challenges associated with integrating agile and UCD. This interview will provide insight into the research area of each agile and UCD and offer future research directions related to Iraqi software development organizations.

4.3 Result of the Interview

In this section, the authors present the findings from interviews with software development engineers in Iraq based on a thematic analysis of the interviewee responses. The sample characteristics, interview dates, venues and method were described with 30 interviews. The responses of the interviews for each interview question's responses were logged into a database, and a thematic analysis was performed to find the primary emergent themes that is, the similarities throughout the various responses. In addition to displaying the responses from each person, the database made it simpler to compare the various answers from each interviewee for each topic. After visually comparing these feedbacks, keywords and phrases exhibiting identical or comparable patterns were found, and their frequency was recorded in the study. The types of in person and online interviews, together with their dates and locations, are listed in Table 8.

Table 8: The Interviews Characteristics

Interview	Position of interviewee	Date of interview	Way of interview
1	Manager	1/5/2023	Face-to-face
2	Developer	5/5/2023	Online
3	Tester	5/5/2023	Online
4	Developer	5/5/2023	Online
5	Developer	7/5/2023	Face-to-face
6	Product Owner	11/5/2023	Online
7	Manager	14/5/2023	Face-to-face
8	Usability expert	18/5/2023	Face-to-face
9	UI designer	18/5/2023	Online
10	Manager	19/5/2023	Face-to-face
11	Developer	21/5/2023	Online
12	Product Owner	24/5/2023	Face-to-face
13	UI designer	28/5/2023	Face-to-face

The interview builds on a semi-structured approach and the first aspect of the questions focused on which UCD methods and techniques practitioners are used when they work on their projects. The result shows that the most often used procedures to elicit the requirements such as "interviews" and "focus groups. Comparing to "survey" and other methods are the least applied (see Figure 5). These obtained results contradict the survey questionnaire results in which some questions were asked. Five interviewers were mentioned "survey", whereas the meeting revealed the "observation method" was more popular compared to the "focus groups" among the interview samples. Several methods come next such as "brainstorming and workshop". Therefore, it is reasonable to conclude that "interview," "prototype," and "observation" are the primary methods utilized to gather requirements, with "workshop and brainstorming" coming in second. In addition to these particular methods, two interviewees stated that they had implemented non-specific procedures involving users without providing a precise method.

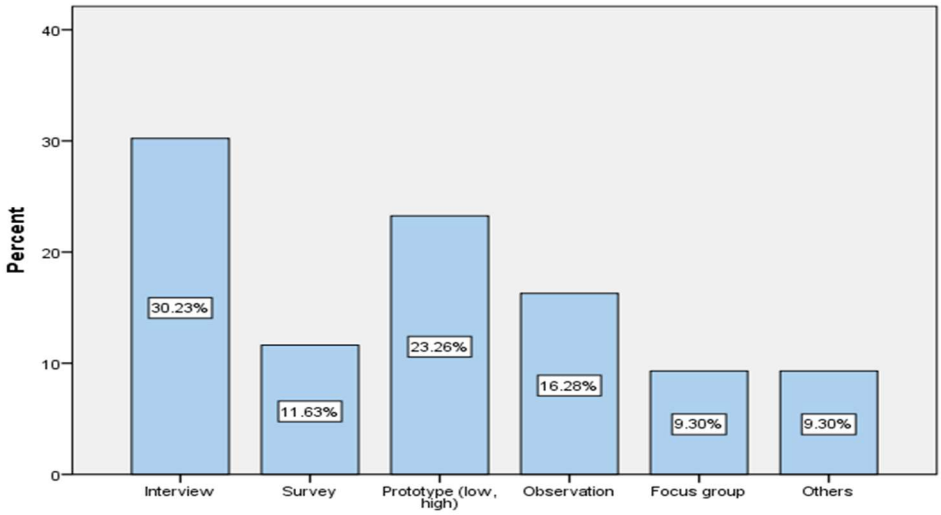

Figure 5: The key Common UCD Methods Used to Capture End-User Requirements

The other aspects of the questions take up developer's responses of how effectively they believe users can dependably use the software they create. Several positive responses arise regarding a

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

UCD philosophy. Putting the end-users of a product at the center of its design and development process greatly increases the likelihood that the final product will be beneficial, useable, and meaningful. Users also need to be involved, and the results show promise in this area as several interviewees emphasized the need of user interaction.

Related Usability is mostly seen by the interviewee as having to do with dependability and simplicity of use, and it is rarely verified after production. Learnability is not given as much weight, despite the fact that it has been confirmed to be supported by meticulous planning, thoughtful design, and user consultation.

The need for meticulous and precise planning was evident in one way or another.

Agile development practitioners need to be more satisfied with the processes in place for guaranteeing software usability. They would like to experiment with an alternative approach to enhance the way needs are captured because of management limitations with rare exceptions. Finally, the practitioners are heard of UCD, although some acknowledge many other methods, and only four (about 7%) expressed no interest in learning about it. However, based on the responses of the practitioners on how well can integrate UCD into agile, the authors summarize the main obstacles that faced software teams during the development process (see Figure 6):

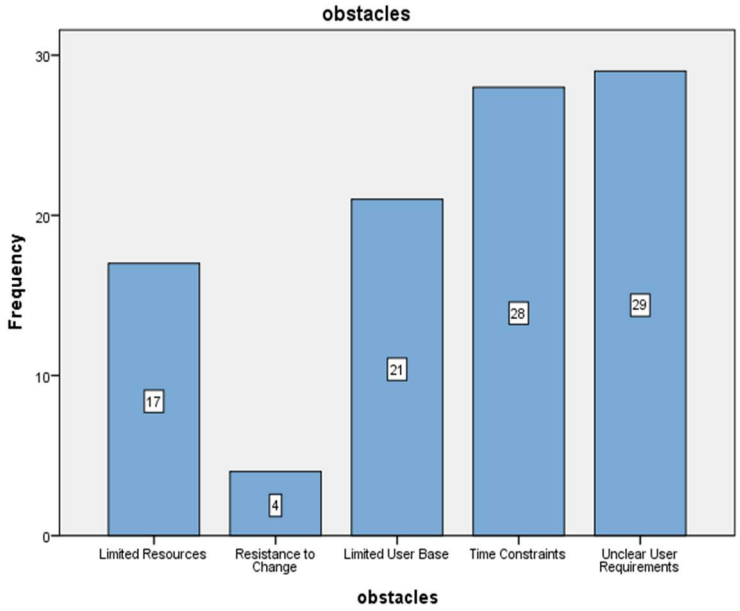

Figure 6: The Agile UCD obstacles

Limited Resources: software development companies in Iraq often need more resources. Implementing UCD requires a significant investment of resources, which may not be feasible for small organizations. Some may need more money to hire a dedicated UCD team or conduct extensive research to understand user needs.

Resistance to change: some participants appeared resistant to change, and some preferred to stick to their traditional product development methods. UCD requires a shift in mindset to priorities user needs and preferences, which may be challenging for some team members.

Limited User Base: within the Iraqi software development environment, there is a narrow user base, which may make it difficult to gather sufficient user feedback. UCD relies heavily on user feedback to inform the design process; hence, there needs to be more user base to provide meaningful feedback.

Time Constraints: the participants claim that they faced tight deadlines and had no the luxury of conducting extensive user research and testing. UCD requires a significant investment of time, which is not feasible for them with limited resources.

Unclear User Requirements: Agile software development focuses on responding to changing requirements and customer needs. However, the lack of clarity in user requirements can make designing products that meet users' needs challenging. UCD requires a clear understanding of user requirements,

behaviours, and preferences, which is unavailable in an agile environment.

5. CONCLUSION

UCD and agile software processes have the same values which can be a keynote for integration, such as customer satisfaction, continuous improvement, and flexibility. This paper is examined based on interviews and survey on the methods of UCD and integrating agile. The evident aspect that comes out of this study is, there is a surge in comprehension of usability in software development: the agile method shows a beneficial impact to UCD for its integration. The participants who have taken part in this study recommend that integrating activities of UCD into the agile development process has strengthened the usability and the quality of products as well as enhanced end-user satisfaction. Finally, the result appeals that several challenges need to be addressed to achieve successful integration: Limited Resources, Resistance to Change, unclear user requirements, Limited User Base, and Time Constraints. For future work, the authors will seek further investigation using observation methods to bring close insight into this integration.

ACKNOWLEDGEMENTS:

The authors would like to acknowledge Al- Bayan University for the financial support of this research paper.

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