Adopting of Agile methods in Software Development Organizations: Systematic Mapping

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Abstract- **Adoption of agile methods in the software development organization is considered as a powerful solution to deal with the quickly changing and regularly developing business environment and fully-educated customers with constantly rising expectation, such as shorter time periods and an extraordinary level of response and service. This study investigates the adoption of agile approaches in software development organizations by using systematic mapping. Six research questions are identified, and to answer these questions a number of research papers have been reviewed in electronic databases. Finally, 25 research papers are examined and answers to all research questions are provided.**

Keywords - **Agile; software development organization; methods; systematic mapping study; adoption.**

1. Introduction:

Agile methodologies emerged in the mid-1990's as a contrasting option to the traditional methods, fundamentally due to the limitations forced by the strict plan-driven and assignment based

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characteristics of the traditional models, similar to Waterfall and its differences [1] [2]. Every single agile approach participates with the same basic values of agility and flexibility [3], and the most popular methods of agile are: Extreme Programming (XP), SCRUM, the Crystal Family, Adaptive Software Development(ASD), Feature Driven Development(FDD), Dynamic System Development Method (DSDM) and Agile Modeling [4] [5] [2] [6].

In addition, Agile methods distinct from the traditional techniques by being iterative as opposed to phase, for example The execution of Agile software development is done in short (2-4 weeks) cycles, each incrementing the software utilizing minimal planning [3] [7] [8]. Agile techniques give deliverables after every iteration, increasing in small subsets of planned out features. In this way they are encouraging interaction, trust, and comprehension between the location clients and the developers [9].

The fact that agile methodologies have become customary in software development organizations around the globe, both small and large ones, because agile can assist to solve the problems related to time-to-market and inadequate primary requirements [10]. Initially, the techniques were intended for tiny in size, collocated ventures [11]. Nowadays, an increasing number of software companies adopt agile methods in order to develop their current programming processes [12] [13]. This means they begin over and over again by embracing new software practices as opposed to enhancing their current procedures [14].

The number of companies that have been attempting to adopt agile methodologies to deal with the developing of software has risen since the Agile Manifesto was released in 2001. Nevertheless, a considerable lot of them have not achieved their adoption objectives, which involve quick and high-quality software deliveries, the customer satisfaction and ability of software products to deal with the change of the requirements during the project development. The outcomes, then again, are limited to the adoption of few practices, so the value of

developed software products was low and furthermore to individuals' potential on delivering them [15].

Adopting agile methods is nevertheless, a very complex process that involves changes to programming development procedure as well as changes to the organizational culture and social patterns and conducts of the stakeholders included [13] [16] [17]. In fact, agile approaches at first expected for use in small, signal-signal-group ventures [18]. Nonetheless, their potential benefits have made them tempting in like manner outside this circumstance, particularly, both for bigger ventures and in large organizations.

So, to find out how can the organization's culture impact the process of adopting agile methods, what are the benefits of adopting agile and the results of adopting agile in large organizations besides other questions related to the process of adopting agile methods in organizations as shown below, a systematic study was carried out to guide our research. This systematic review tries to assess, synthesize, and introduce the existing findings.

The outline of this paper is introduced as following: Section II illustrates some related research; Section III presents the systematic study; Section IV reports the results of the study; Section V discussion part; Section VI contains threats to validity; Section VII conclusion, limitations and future work.

Research Questions:

RQ1. Why do the organizations motivate to adopt agile methods in software development?

RQ2. Are the agile methods adoption beneficial for the organization?

RQ3. What are the Challenges in agile methods adoption in software organization?

RQ4. Are there guidelines provided for agile methods adoption in organization?

RQ5. How large software development organizations can scale agile methods for complex software projects?

RQ6. How the organization's culture impact agile methods adoption?

2. Background

Agile software development (ASD) techniques are frequently announced as a differentiation to the traditional, plan-driven method to deal with software development [19] and the announced and contended benefits are various. ASD techniques are alleged to raise the quality of software [20], enhance communication [21] and in addition, coordination [22] and raise productivity [23]. The Agile Manifesto [24], made in 2001, records a set of values whereupon ASD depends. Alongside these values, there is additionally a list of principles. Principles are "domain-specific guidelines for life" [25], indicating how the values can be used in various areas. Thirdly, there are practices, which are significantly more specified.

There were some researches conducted related to the rate of companies that adopted agile methodology at the starting of declaring it. There were two studies conducted back in 2005 that gave information about the rate of adoption of agile methods. The first survey was administrated by MethodsAndTools.com [26], and indicated that about 40% of the 232 members' organizations had utilized agile approaches and around 20% were assessing them in pilot ventures.

The second survey, coordinated by Schwaber and Fichera for Forrester Research, communicates that around 14% of North American and European companies were using agile techniques and another 19% desired to utilize them in the immediate future [27]. This survey furthermore induces that while the early adopters were ordinarily smaller firms making high-tech products, the present adopters tended to be information technology groups inside huge companies.

In the interim, agile methodologies are productive in some circumstances, huge and complicated software products as often as possible require efficient preparing with the required additional process to ensure success. Agile designing is a similarly informal process with various little undertakings to ensure perfect delivery results [28]. The congruity of agile methods to deal with huge organizations is often thought about as challenging [29] [30]. In big-scale ventures, the issue rises as the complexity of the application space is regularly beyond the experience or skill of a few customers and moreover engineers. There is an obvious necessity for progress with customer engagement in expansive scale complex ventures and it is the fundamental key for XP extends accomplishment [31]. Starting now, organizations are gradually deploying agile methods in their product development projects.

The fact that organizations nowadays are examined by a fast changing and continuous building up business environment and fully-educated customers with persistently rising anticipation, such as shorter time periods and an extraordinary level of response and service [32][33]. Currently, the Agile has risen the size of the success of stories in software development field, and for this reason it has become adopted vastly by various organizations due to the

upsides of Agile that make utilizing them. So, utilizing agile methodologies have many advantages as some researches are proposed which make the Agile methods the first option for developing in any type of venture. [34][35].

3. Research Methodology

A systematic mapping study (SMS) is a research technique concerned with investigating the literature in a specific field of interest and creating a survey to recognize gaps that require further evaluation [36]. For this reason, it was used to answer six research questions in concern with adopting agile methods in software development organizations.

As figure 1. Shows there were three main steps in the research method applied which are identifying research questions, the search strategy and the study selection process.
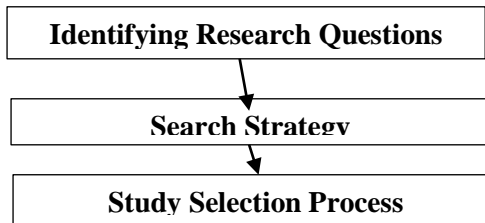
Identifying Research Questions
Search Strategy
Study Selection Process

Fig. 1. Research Methodology

1. Identifying research questions: Six (RQs) are identified to determine the initial studies that explore adopting agile methods in software development organizations, which are:

RQ1. Why do the organizations motivate to adopt agile methods in software development?

RQ2. Are the agile methods adoption beneficial for the organization?

RQ3.What are the limitations in agile methods adoption in software organization?

RQ4. Are there guidelines provided for agile methods adoption in organization?

RQ5. How large software development organizations can scale agile methods for complex and software projects?

RQ6. How the organization's culture impact agile methods adoption?

2. Search strategy: The key words and their synonyms were identified to search for relevant documents from electronic databases: "agile", "adopting", "software development organizations"]. A logical operator AND was used to make a group of the basic terms. The final research series that we got is: [("adopting agile" AND "software development organizations").

Five electronic databases (DB) were utilized in the mapping study to get quicker outcomes: ACM Digital Library IEEE Xplorer, Springer, Google Scholar and the Web of Science as it is shown in Table 2. With a specific end goal to guarantee the quality of the outcomes, the recognized literature must be reviewed in pairs.

Table 1. Selected databases

Source	Location
IEEE Explore	http://ieeexplore.ieee.org
ACM Digital Library	http://portal.acm.org
Springer	https://link.springer.com
Google Scholar	https://scholar.google.com
Web of Science	http://apps.webofknowledge.com

3. Study selection process: Several searches of electronic databases are conducted using the search string. We found initially 190 Preliminary studies on adopting agile in software development organizations. The selection criteria were applied by reading the title and abstract sections of these papers and the number of papers was reduced to 25 papers as shown in Table 2.

The choice criteria concentrate on adopting agile in software development organizations papers. There were some papers that were barred in light of the following criteria: studies that not relate to the topic, papers not provided in English and studies not available in full-text.

Table 2. Articles include SCRUM

Database	Obtained	Included
IEEE explore	50	6
ACM digital	30	2
Springer link	20	4
Google Scholar	60	6
Web of Science	30	7

4. Results:

RQ1. Why do the organizations motivate to adopt agile methods in software development?

The organizations motivate to adopt agile methods in software development for many reasons. According to Shen et al. (2012) agile software development method was the answer to how the software development companies can be more organized in order to deliver quicker, better and inexpensive solutions because of the large market demand [37]. For example, IT companies try to develop the effectiveness and general standard of their product development effort by adopting agile software development practices [38]. The other reason for adopting agile methods is that it provides fast and high-quality deliveries of software, programming products that better fulfill clients' needs and adaptability to manage scope changes all through the venture [40]. Some researchers stated that the number of software organizations that adopt agile increased because agile methods help them to improve their existing software processes [12] [13].

Moreover, requirements are basic for the achievement of software ventures. It is not easy to produce requirements, as the hardest phase of building a software system is to choose what the system ought to do, and requirements errors are costly to fix in the later periods of the product improvement life cycle. So, to avoid such problem, agile methodologies are adopted in different stages of software development cycles [39]. On the other hand, according to Silva and Goldman (2014), the traditional culture of the organizations could be viewed as their fundamental motivation to move to adopting agile [40].

RQ2. Are the agile methods adoption beneficial for the organization?

Yes they are, the agile methods adoption was beneficial for the organization in different aspects such as enhancing customer value, increase the quality and develop organizational confidence [41][42], it also was proved that adopting agile methods provide opportunities to improve products in terms of quality. In addition, the use of agile methods provides positive effect on the product development efficiency and effectiveness [43], and

according to Lagerberg et al. (2013) implementation of agile principles and practices lead to raise of the venture visibility and coordination effectiveness, decrease of the requirement for different sorts of coordination mechanisms and raise of the productivity [44].

In general, adopting agile methods in software development organizations brought many benefits, for example, ability to deal with requirements changes, productivity return, and business alignment, it also can deal with plan, cost, workforce turnover in an efficient way in companies[45] [46]. According to Korhonen (2013), adoption of agile methods practices also have the beneficial effects on the large organizations [47].

RQ3.What are the challenges in agile methods adoption in software organization?

There are many challenges which can be faced during adopting agile methods which require a basic organizational change to create the transition successful, such as the technical prospects, the complexity of product development and social prospects of software development [48].

Moreover, there is another challenge that should be taken into account when adopting agile which is the management of agile methodologies [49], because the mismanagement of management aspect can lead to delay in the schedule, increase costs and loss of productivity [43]. Sustainability, measuring agile value, and understanding cultural change is very complex which make them challenges to the organizations when adopting agile methods [50].

RQ4. Are there guidelines provided for agile methods adoption in organization?

There are some guidelines that can be used for agile methods adoption in organizations, Nikitina and Mattsson (2011) recommended a procedure model of software method adoption and list circumstantial factors for managing the deployment of software development methodologies. The model is called Software Method Adoption (SMA). It involves the list of methodology adoption activities exercises that are organized in stages and a set of circumstantial factors that should be considered while changing programming processes. The SMA model is illustrated on two levels: phase and activity levels [52].
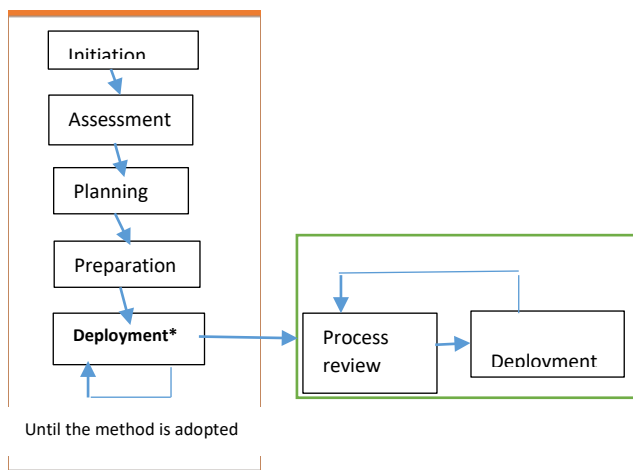
* The phase of deployment can be repetitive or may be implemented once.

Figure 2. General representation of the SMA procedure model. Adopted from [50].

Meanwhile, Pikkarainen et al. (2011) exhibited a framework that can be used to support a systematic choice and deployment of new agile practices and for adjusting them to suit the organizational framework which is called an agile deployment framework. This framework involves the processes and methodologies required for choosing appropriate new agile practices in a company [18]. In addition, according to Pikkarainen (2011), identifying barriers, strengths, and suggestions can be utilized as a checklist for arranging as well as checking the effectiveness of deploying agile methods in software organizations [52].

RQ5. How large software development organizations can scale agile methods for complex software projects?

Recently, various frameworks for scaling agile have been made by advisors, involving the Scaled Agile Framework (SAFe), Disciplined Agile Delivery (DAD) and Large-scale Scrum (LeSS) [53]. As per the State of Agile Survey, the Scaled Agile Framework (SAFe) is by all accounts the most popular Framework for scaling agile [54]. Paasivaara (2017) used the Scaled Agile Framework to scale agile methods for complex software projects [54]. The Scaled Agile Framework (SAFe) demands to offer a recipe for agile adoption at the company scale [55]. It includes the levels of groups, programs, and portfolio, and in addition, the possible value stream level [56].

RQ6. How the organization's culture impact agile methods adoption?

The organization's culture is believed to have an impact on the degree to which an agile methodology is utilized by agile methodologies advocates [57]. It is also thought to be a factor affecting successful adoption of agile [58] [59]. There were many types of researches that were conducted in attempt to find out the impact of organizational culture on agile methods adoption.

Strode et al. (2009) conducted a study to investigate the relationship between organizational culture and agile method usage, they found a number of organizational culture factors that related to the utilization of the agile methods such as "the organization values feedback and learning, and social interaction in the organization is trustful, collaborative, and competent". The more prominent the degree of these factors in the companies studied, the higher was their agile technique utilization value [57].

On the other hand, organizational culture has an impact on the work in the organization, affecting the routine, delivery of the work, and productivity [60]. It also affects staff members routine, pecking order, connection, collaboration, and it rises when a list of assumptions are set up by a team, becoming consolidated and repetitive in the day by day fill in as the "right form" of administering the work [61].

5. Discussion

In this study, five electronic databases were utilized in the search process which are: IEEE Explore, ACM Digital Library, Web of Science, Google scholar and Springer Link, and the topic of the search was the Adopting of Agile methods in Software Development Organizations. As a result, approximately 190 researches on the topic were found, but only 25 of them were related to the research subject. A number of research questions were prepared to help us during the search.

Research Questions:

RQ1. Why do the organizations motivate to adopt agile methods in software development?

The software organizations' motivation for adopting agile methods can be divided into three reasons:

Dealing with the large market demand to deliver quicker, better and inexpensive solutions [37].
Adopting agile methods to ensure fast and high-quality deliveries of software, programming products that better fulfill clients' needs and adaptability to manage scope changes all through the venture [40].

The traditional culture of the organizations could be viewed as their fundamental motivation to move to adopting agile [40].

RQ2. Are the agile methods adoption beneficial for the organization?

Yes, the agile methods adoption can be beneficial for the organization in different aspects such as enhancing customer value, increase the quality and develop organizational confidence [41][42].

The use of agile methods provide positive effect on the product development efficiency and effectiveness [43], and it raises the venture visibility and coordination effectiveness, decrease the requirement for different sorts of coordination mechanisms and raise the productivity [44]. So, adopting agile methods in software development organizations brought many benefits, for example, the ability to deal with requirements changes, productivity return, and business alignment [44]. According to Korhonen (2013) adoption of agile methods practices also has the beneficial effects on the large organization [47].

RQ3. What are the Challenges in agile methods adoption in software organization?

Many challenges can be faced during adopting agile methods which require a basic organizational change to create the transition successful which are:
The technical prospects, the complexity of product development and social prospects of software development [48]. Also, others are: the management of agile methodologies [49] and sustainability, measuring agile value, and understanding cultural change is very complex [50].

RQ4. Are there guidelines provided for agile methods adoption in organization?

There are few guidelines that can be used for agile methods adoption in organizations, Nikitina and Mattsson (2011) recommended a procedure model of software method adoption and list circumstantial factors for managing the deployment of software development methodologies. The model is called Software Method Adoption (SMA). [51]
There is also a framework that can be used to support a systematic choice and deployment of new agile practices and for adjusting them to suit the organizational framework which is called an agile deployment framework [18].

RQ5. How large software development organizations can scale agile methods for complex and software projects?

There are many frameworks that can be used to scale agile such as the Scaled Agile Framework (SAFe), Disciplined Agile Delivery (DAD) and Large-scale Scrum (LeSS) [54] but the most popular Framework for scaling agile is the Scaled Agile Framework (SAFe) [54].

RQ6. How the organization's culture impact agile methods adoption?

There are many types of researches conducted in attempting to find out the impact of organizational culture on agile methods adoption. The results of these studies can be summarized as following:
The more prominent the degree of cultural factors in the companies studied, the higher was their agile technique utilization value [57]. Organizational culture has an impact on the work in the organization, affecting the routine, delivery of the work, and productivity [60]. It also affects staff members routine, pecking order, connection, collaboration, and it rises when a list of assumptions are set up by a team, becoming consolidated and repetitive in the day by day fill in as the "right form" of administering the work [61].

6. Threats to validity

The validity issues are basically in the papers' chosen process. Particularly, the issue related to the possibility of losing relevant studies. To guarantee the fullness of our paper repository, the most known scholarly web indexes, including IEEE Explore, ACM Digital Library etc. are selected. Moreover, various combinations of the topic of interest and their synonyms related to agile strategies in software development organizations are used.

7. Conclusion, Limitations, and Future Work

Conclusions: Adopting agile methods in software organization is beneficial for these organizations in different aspects such as providing fast and high-quality deliveries of software, software organization are motivated to adopt agile methods because it is the proper answer for some problems that can be faced such as the large market demand requirements to deliver swift, better and inexpensive solutions. In addition, the process of adopting agile methods may not be easy, so there are some guidelines that can be used during adopting agile, for instance an agile deployment framework.

Organization's culture has an impact on agile methods adoption because it is a significant factor affecting successful adoption of agile. Large software development organizations can scale agile methods for complex and software projects by using various frameworks such as (SAFe) which is the most popular Framework for scaling agile. For the future work, further research can be done to discover if software organizations prefer to adopt agile methods completely or combining them with traditional methods and identifying reasons behind their selection process.

In this study, the main limitation is the bias in the selection of publications, the keywords and search terms were identified to allow us to identify the relevant studies. It is essential to know that, the software engineering keywords are not standardized and that they can be both disciplines- and language-specific. Thus, because of our selection of keywords and search strings, there is a hazard that relevant studies were overlooked. There is also a possibility of missing some relevant studies that are included in other databases because five electronic databases were used in this study.

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