

The main pillars of Agile consolidation in newly Agile teams in Agile software development

Tayebe Mohamadi Gahroee¹, Taghi Javdani Gandomani², Mohammadreza Soltan Aghaei²

¹Department of Computer Engineering, Faculty of Engineering, Isfahan Branch, Islamic Azad University, Isfahan, Iran

²Department of Computer Science, Faculty of Mathematical Sciences, Shahrekord University, Shahrekord, Iran

Article Info

Article history:

Received Nov 1, 2021

Revised Mar 9, 2022

Accepted Mar 21, 2022

Keywords:

Agile adaptation

Agile adoption

Agile consolidation

Agile software development

Agile methodologies

Agile transition

ABSTRACT

Many software companies and teams use Agile methods as their main development approach. These methods promise higher team productivity, faster product delivery, a more flexible development process, and greater customer satisfaction. Nevertheless, a review of the literature shows that adapting to these methods, known as Agile transition, is not as easy as expected. However, several frameworks and models have been proposed to facilitate the Agile transition process. The challenging issue after the transition to agility is the behavior of companies and teams after the Agile transition and how to maintain agility in the long run. Very little research has been done on this issue, which has largely expressed concern. The present study tries to explore the hidden aspects of the transition to agility and provide a solution for Agile consolidation in newly Agile software teams. In this regard, using the grounded theory approach, the basic theory of Agile consolidation in these teams has been presented. Preliminary findings of the study indicate important factors that play an important role in Agile consolidation. Identification of challenges, facilitators, organizational culture structure, and human roles in Agile consolidation is the most important initial findings of this study.

This is an open access article under the [CC BY-SA](https://creativecommons.org/licenses/by-sa/4.0/) license.



Corresponding Author:

Taghi Javdani Gandomani

Department of Computer Science, Faculty of Mathematical Sciences, Shahrekord University

Shahrekord, Iran

Email: javdani@sku.ac.ir

1. INTRODUCTION

In the past few years, the agility of software teams has been one of the options facing software companies, but today it has become a necessity. Although the field of Agile software development and its attitude is not very precisely defined in the literature, the use of Agile practices, Agile methodologies, development based on the Agile principles, and the like are relevant examples [1], [2]. What is important here is to achieve the values that have made Agile teams and companies eager to use these methods. It is clear that most of these values must have a business and economic approach that can put teams and software companies ahead of their competitors and give them business maneuvering power. In fact, the Agile perspective is one of the examples of process improvement, at the heart of which is the pursuit of business values and the interests of stakeholders [3], [4]. Despite the structural differences in the multiple methodologies, which are largely due to their origins and different practices, they all follow the same values and principles. In fact, the value structure governing these methods follows a specific pattern introduced in the Agile Manifesto and adheres to the Agile principles [5].

In an ideal approach, Agile is not simply the performance of some specific practices derived from the Agile methods, but the achievement of values and improving the structure of team software development.

What is meant by Agile transition is the output of the transformation process and not the transformation process itself [6], [7]. Of course, in the transformation process, many considerations must be taken into account, which has been discussed in many previous studies [8]–[10]. Special attention has been paid to studies on providing solutions for the process of transition to Agile. This has led to the provision of models or frameworks in this field. In fact, more efforts have been made to use and adopt Agile methodologies and Agile transition. But little attention has been paid to the institutionalization of Agile and the sustainability of the use of Agile methods.

The important point is that the ultimate goal of the Agile transition is to improve the Agile software development structure and consolidate Agile methods and detect anti-Agile factors. In fact, the goal is not just the use of a few Agile practices. This improvement must be such that it has the necessary durability and stability over time. This shows a scientific and practical gap in the use of Agile methodologies. A review of the literature shows that so far, no proper attention has been paid to this challenge. Focusing on this challenge, the present study uses grounded theory to try to provide a solution to establish Agile in newly Agile software teams. The other sections of this paper are organized as follows: Section 2 provides an overview of the proposed frameworks and models for the Agile transformation process in software teams and companies. Section 3 shows the challenges of Agile adaptation in software teams. Section 4 addresses the ambiguous aspects of Agile consolidation. Section 5 summarizes the employed research methods. Section 6 deals with the initial findings of the research, and finally section 7 presents the conclusions of the article.

2. AGILE TRANSITION PROCESS

The Agile transition process is known as a socio-technical process that involves a major shift in cultural and technical practices in software companies. Hence, the Agile transition process requires extensive changes in various aspects of a company. A process of transition to true Agile must focus more on being Agile than on doing Agile practices. That is why this process will not be so simple. In fact, Agile adoption is not just about following specific methods defined by Agile methods. The Agile transition process is known as the process of abandoning traditional software development methods and adopting Agile software development methods. Contrary to many people's beliefs, the Agile transition process is not easy and is subject to many challenges and issues. The main reason for these challenges is the fundamental differences between disciplined and Agile software development approaches, each of which focuses on different values and practices [11].

The Agile transition process represents the process by which software teams adapt to Agile methodologies. Different models and frameworks have been proposed for this process. A review of the literature shows that although these few studies have attempted to provide a framework for the Agile transition and adaptation, the proposed frameworks are both subject to serious criticisms and have shortcomings that make them difficult to apply in practice. However, each of them has advantages that are helpful in certain situations. In one of their articles, Boehm and Turner [12] introduced a simple framework that helps software companies and organizations choose traditional or Agile methods or a combination of the two. In this study, five basic decision factors including size, sensitivity, culture, individuals, and dynamics are defined. This study has proposed a step-by-step approach in which decisions are made by evaluating and measuring the organization and the project and ranking the five factors in relation to the balance of discipline or agility [12], [13]. This framework has a risk-based approach core. Although this framework does not discuss how to adapt to Agile methodologies and does not address this issue, the general acceptance of Agile methods and human factors in the choice of development methodologies at the time, by the creators and theorists of traditional methods is interesting and it has been thought-provoking.

In the paper, Sidky *et al.* [14] inspired by the capability maturity model integration (CMMI) model, a multi-step framework for Agile transition and adaptation has been proposed. The study also developed an agility measurement tool that measures the maximum degree to which a company can achieve agility. The proposed framework of this study is based on this agility index. This framework has defined more than 300 indicators to assess the agility of organizations. It is clear that examining this number of indicators is not only very time-consuming but also requires the appointment of an expert to perform the Agile assessment process. In addition, applying such a complex and disciplined framework requires a huge organizational superiority, which is in stark contrast to the philosophy of Agile. In another study, Javdani *et al.* [7] by performing empirical research provided a real framework for adapting to Agile. The proposed framework in this study is based on grounded theory and tries to use the intrinsic aspects of Agile thinking to establish and apply its practices. The proposed framework, while considering the process of Agile transition and adaptation as a permanent process, has not entered the post-transition period and has not made any suggestions in this regard.

In another study, an agility transition framework is proposed that covers the main three-phase class [15]. These three phases are called the preparation phase, the transition phase (at the team level), and

the transition phase at the organization level, respectively. The most important focus of the first phase is to adopt an appropriate strategy according to the company's goals and internal capabilities and then to plan for the transition process. In the second phase, the implementation of an Agile method and the necessary analysis of the degree of business improvement achieved, as well as team and individual adjustments are considered. In the third phase, continuous improvement at the level of the organization and the project, along with attention to inter-team coordination in distributed environments is considered. The initial evaluation of this framework showed improvements at the organizational level, but this study lacks an empirical evaluation in the real environment. It also did not pay attention to different and detailed aspects such as training, evaluation, transition management, and cultural issues, which are often challenging.

Scaled agile framework (SAFE) [16] is one of the resources considered by software companies. This framework is a set of organizational patterns and workflows that helps to scale Agile and pure thinking. The framework is more focused on addressing challenges that go beyond a team, and in fact, focuses on inter-team communication, but is less involved in Agile adaptation and issues within the team. Also, the full implementation of this framework will bring a lot of executive burdens, which itself contradicts the Agile thinking. The framework also provides longer planning periods and defines more jobs, which in turn reduces the team productivity promised in the Agile approach. But in addition to these limitations, attention to inter-team issues is one of the positive points of this framework, although this framework does not offer an idea about Agile consolidation [17].

In another study, Frenstrom [18] in his doctoral dissertation at the University of Phoenix, based on the proposed framework of gandomani and nafchi [7], provided a framework for changing individual and organizational culture in the Agile transition process. In this context, practices focusing on cultural issues and mindsets are considered and the entry into technical practices as well as executive models of software engineering is avoided. However, this framework, along with more general frameworks in this area, can help to adapting to Agile more safely and easily; this framework, like the others, has not entered into post-adaptation conditions.

Finally, a recent study reviewed Agile transition frameworks [7]. The purpose of this study is to systematically analyze the background of the Agile adaptation process and identify potential gaps in the existing research process to gather evidence of Agile adaptation and transition. The questions that were considered in this study were "What is the framework for Agile adaptation and transition in the background? What topics and aspects are discussed in the Agile adaptation and transition background and how can they be grouped and What are the situational factors affecting the Agile adaptation and transition process?" This study, while reviewing the few frameworks presented in this field, has also stated the effective factors as well as the obstacles of this process and has considered the necessity of paying attention to these cases and finding solutions to overcome these problems.

In addition to the above, unfortunately, the experience of the post-Agile era and how to stay Agile has not yet been presented. Also, while the challenges of the Agile transition process are still one of the serious issues in which industrial and academic research is active [17], [19]–[21], it seems that attention to Agile durability is still at the beginning of the road and needs to be studied more carefully until a suitable solution is provided. However, staying and being Agile has a number of issues that may make it difficult to achieve full agility in practice, which will be mentioned in the next section.

3. AGILE ADAPTATION AND ADOPTION ISSUES

3.1. Personal issues

Agile is basically about changing the personal attitude of teams and developers in software projects. This fact is enough to understand the extent to which personal challenges in this area can be influential factors [19], [22], [23]. Personal factors are inherently resistant to accepting executive change, and especially mental change. Also, the Agile approach inherently emphasizes the existence of power and creativity. The ability to be creative requires breaking the rules and should not be organizational. So, even if you accept Agile, and get used to a set of Agile practices, this itself can be an obstacle to staying Agile that needs to be addressed [24].

3.2. Managerial and organizational issues

The second category of issues is related to organizational and team management. In practice, self-organization defined in Agile software development is considered an undeniable principle. This requires diminishing the role of organizational and project management in Agile development, but in practice, the problem is not so simple. In the first place, managers are often worried and upset about the reduction of their authority and will try to somehow escape from this organizational constraint. This sometimes leads to managers not committing to Agile acceptance and adaptation, and sometimes if the team becomes Agile, it is

accompanied by limitations and challenges [22]. This sometimes leads to psychological challenges in the team and organization [25].

3.3. Structural and process issues

Another category of issues goes back to the environment of using Agile methods. Numerous factors are challenging in this area, such as multi-site companies, distributed teams, and incomplete development processes or processes that inevitably ignore some principles of Agile due to the lack of certain requirements. In particular, the widespread trend towards global software engineering has led to challenges in adapting to agility due to violations of the co-location principle in Agile development, which are sometimes not easily overcome and in most cases are accompanied by an executive and managerial overloads that also lead to a decrease in organizational agility [20], [26].

Along with this, the scalability of Agile software development is also a serious challenge. This challenge stems mostly from the nature of small teams in Agile development and contradicts the multi-site nature of software projects. However, today, the tendency towards developed and multi-team environments is an unavoidable necessity, and the study of issues related to this sector is still seen in different sectors, and various solutions and implementation frameworks are sometimes used to cover some of the consequences of this challenge [27], [28]. But in staying Agile, problems seem to have changed in form, and personal and structural problems remain. In addition to these problems, there are several ambiguities regarding the lack of permanent agility, examining these ambiguities and answering them can help researchers and software professionals in Agile consolidation. The next section briefly addresses the ambiguous aspects of Agile consolidation in this field.

4. AGILE CONSOLIDATION ASPECTS

Agile adoption is the core process of taking advantage of Agile. As mentioned earlier, achieving Agile goals, including competitive and commercial benefits, is the ultimate goal of the adaptation process, but the important point is that compliance with Agile alone should not be the final goal, but Agile consolidation should be sought in executive environments. In this regard, no solution shows what to do after adapting to Agile. How to establish a culture has always been one of the serious challenges of organizations? Due to its specific nature, there will be special challenges in consolidating the use of Agile methods and practices. The Agile consolidation framework is ambiguous in the following aspects:

- Factors affecting Agile consolidation: One of the first and most obscure issues is what Agile consolidation depends on in practice and how these factors can be effective in Agile stabilization.
- Evaluation method: Achieving the Agile goals without having a proper method to evaluate the degree of agility cannot be very meaningful. Criteria need to be defined so that the team can measure its consistency in taking advantage of Agile at different or specific time intervals and measure adherence to Agile.
- Structure and elements of the consolidation framework: Adaptation frameworks are presented to establish Agile practices in organizations, but the structure and elements of the model of Agile consolidation are ambiguities in this area. It is necessary, in terms of effective key elements, to suggest a solution for how to use them in practice.
- Process hierarchy: In addition to the model structure, it is necessary to define the method of using agility practices/activities in the form of the process hierarchy.

A review of the literature shows that Agile consolidation has not yet been studied in general and its various dimensions are still unclear. The reason for this is that many companies are still involved in the Agile adaptation process and this process is still under study. It seems that exploring the ambiguous aspects of Agile consolidation can help researchers to develop Agile consolidation models or frameworks in newly Agile software teams. It should be noted after successful adoption, many practices need to be changed and employed in different ways. For instance, risk management, project management, and knowledge management. Will be seen differently from what was adopted before the Agile transition [29]–[32]. Thus, focusing on such a huge change in all aspects of software development, providing an Agile consolidation framework is necessary.

5. RESEARCH METHOD

This research is based on the Grounded Theory. Due to the nature of the issue under study, the use of empirical and real data can help to achieve a suitable framework that can be used in practice. Basically, in cases where personal or organizational behaviors are considered, the use of qualitative research methods is a more appropriate method to achieve more efficient results. The main reasons for choosing this method are:

Grounded Theory is one of the best tools to achieve appropriate results in cases where personal and social issues are the dominant factors in a phenomenon [33], [34]. Software development processes in general and Agile software development methods, in particular, are based on the critical role of individuals, and therefore, this research method can play a key and effective role. It is also very effective in cases where there is still a lot of ambiguity about a phenomenon [34]. No outstanding academic work has yet been done on institutionalizing the transfer and Agile consolidation, and hence grounded theory is a good alternative. While other research methods mainly seek to validate the researcher's hypotheses, the Grounded Theory, regardless of the definition of a particular hypothesis, rely on real data and gives the researcher the necessary freedom to achieve the real theory [35], [36]. This demonstrates the appropriateness of the grounded theory in the case of the Agile consolidation process, in which it is not yet wise to formulate a particular hypothesis. Figure 1 shows the steps used in this research based on the grounded theory method.

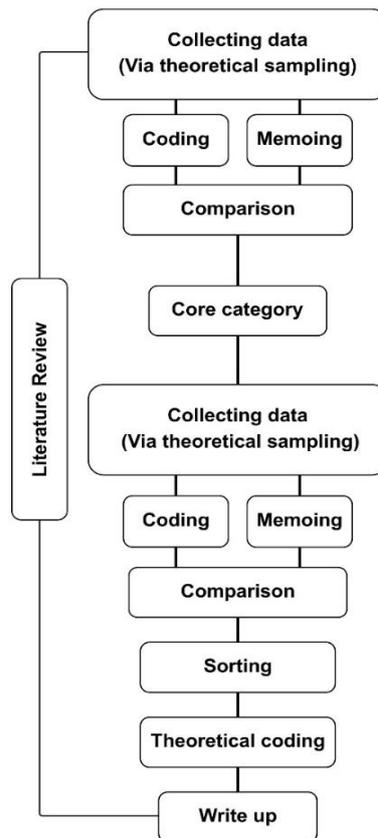


Figure 1. The grounded theory steps adapted from [36]

5.1. Research participants

This study was carried out with the participation of several experts from various countries. Initially, a call was made to participate in this study on social networks such as LinkedIn. In this call, presence and work experience in agile companies and having experience in agile transformation processes were announced as prerequisites. After identifying the candidates, with their agreement, the time of the interview was determined and the interview was conducted. At the end of each interview, they were asked to name another expert they knew. After correspondence with the introduced experts, the desire to be interviewed was also discussed with them. As grounded theory recommends, data collection should be continued until reaching data saturation. This study is still ongoing and the number of participants will be determined at the end of the study. However, the primary findings are extracted based on the participation of 10 experts. Table 1 shows the details of the participants.

Table 1. Details of the research participants

ID	Role	Experience in software development	Experience in Agile software development	Adopted method(s)
P1	Developer	11	7	Scrum, Kanban
P2	Developer	6	5	Scrum, XP
P3	Scrum Master	13	8	Scrum, Kanban
P4	Scrum Master	17	6	Scrum
P5	Scrum Master	5	5	Scrum, Kanban
P6	Developer	7	5	Scrum, XP
P7	Senior Manager	20	5	Scrum, Kanban
P8	Product Owner	9	6	Scrum, Kanban
P9	Developer	7	5	Scrum
P10	Developer	7	3	Scrum

6. PRELIMINARY FINDINGS

Given that this research is in the data analysis stage, it is difficult to judge the final model extracted from the data. However, the preliminary results of the data analysis indicate important points that are likely to be seen in the final output of this study. The most important of these cases are briefly stated below.

6.1. Challenges of Agile consolidation

Preliminary findings of this study indicate that Agile consolidation in teams faces many challenges and difficulties. Figure 2 illustrates these challenges. As can be seen in Figure 2, the Lack of active customer participation and awareness of Agile values is one of the challenges of Agile consolidation. One of the most important challenges is to keep the teams Agile permanently.

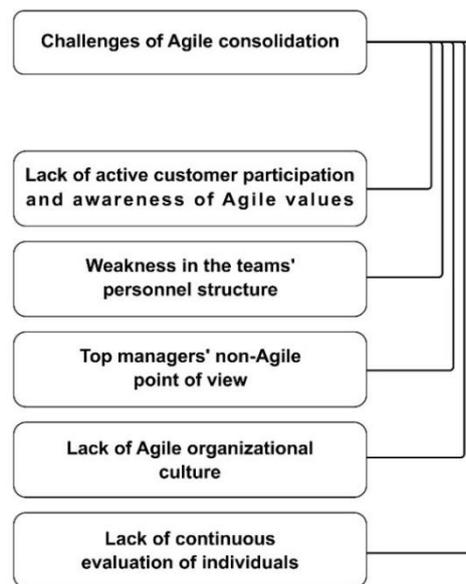


Figure 2. Challenges of Agile consolidation

6.2. Agile consolidation facilitators

In addition to the challenges of data analysis, several cases have been identified as Agile facilitators in data analysis. The most important of these are shown in Figure 3. As shown in Figure 3, factors such as the existence of an appropriate organizational culture, the right mindsets of individuals about Agile, constant staff training, the real need for becoming Agile, and personnel incentives are the most important factors.

6.3. Role of individuals in Agile consolidation

Individuals can play both positive and negative roles in Agile consolidation. Figure 4 shows the positive or negative roles of individuals in this regard. In Figure 4, the customer can play a negative role due to the lack of awareness of Agile values and processes. Also, top and middle managers with their incorrect interventions are one of the negative personal factors in Agile consolidation. In addition, technical people and team members sometimes play a negative role due to the lack of commitment to Agile. The presence of experienced Agile leaders and advisors can play a positive role in Agile stabilization. Agile champions, who

usually act as team members, also have a positive role to play in Agile consolidation. Top and middle managers, customers, and members of Agile teams who have a positive mindset and a good understanding of Agile and its values also play a positive role in keeping teams Agile.

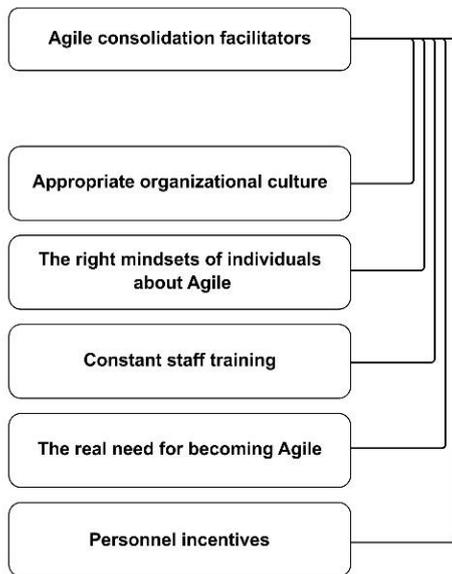


Figure 3. Agile consolidation facilitators

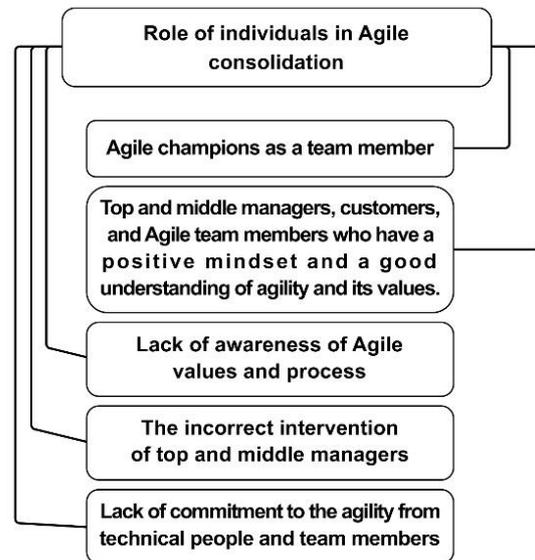


Figure 4. Role of individuals in Agile consolidation

6.4. Agile organizational culture

Data analysis shows that Agile consolidation is not possible without an Agile organizational culture. Figure 5 shows the cases extracted from the data analysis in this regard. As can be seen in Figure 5, items such as defining organizational values compatible with Agile, adhering to Agile requirements in organizational layout, defining appropriate incentives and punishments, creating Agile compatibility mentality among individuals, and prioritizing cultural change over changing processes are the most important things that help teams in defining and organizing an Agile organizational culture.

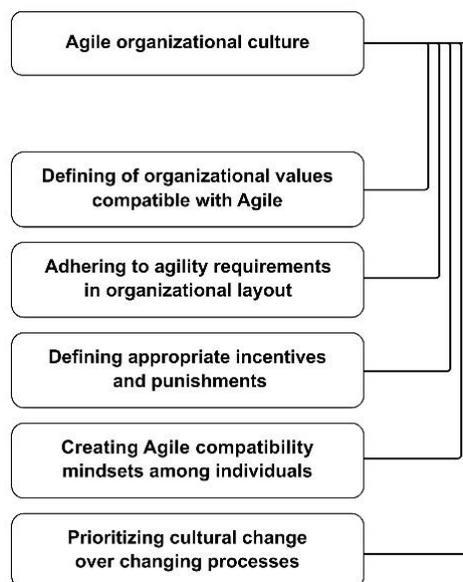


Figure 5. Agile organizational culture

7. DISCUSSION

The findings of this study at this stage show the main pillars of Agile consolidation in newly Agile software teams. In these teams, at the same time, serious attention should be paid to issues such as challenges and facilities for Agile consolidation, having an appropriate organizational culture that meets with Agile structure, and paying attention to the positive and negative effects of organizational roles in Agile consolidation. The challenges that put Agile consolidation at risk, at first glance, are not much different from what have been reported in Agile transition [22], [37], but they will show their criticality when we find out that Agile consolidation usually occurs in the long run and eliminating these challenges during the transition process does not lead to full elimination. In fact, these are inherent problems that threaten the pillars and values of agility in software teams [38]. Previous studies have addressed these challenges or reduced them in the transition process, but until Agile is institutionalized, teams may face these challenges at any time [37]. Although in the results of the present study, no solution has been shown on how to address these challenges, it seems that some related studies have provided solutions in this regard [39]. Another important point to note is that transition projects are usually controlled and supervised and many of these challenges are managed, but after the transition process is over, other projects are not under control and these challenges are more likely to occur.

Another aspect of Agile consolidation is facilitators who help teams and software companies to maintain their agility over time in an easier manner. The most important of these facilitators is the organizational culture that helps them stay Agile and think Agile. This issue has been emphasized in many other studies and it seems that without this case, achieving Agile goals will not be possible [40], [41]. In addition to this factor, the appropriate mindsets of individuals, feeling the real need for agility as a product development strategy, the definition of personnel incentives, and constant staff training are other facilitators of Agile consolidation. A review of the literature also shows that in some cases these factors have been suggested by other researchers [41], [42]. In particular, the role of training in transitioning to Agile and staying Agile has been considered by researchers in several studies [43], [44]. Also, the appropriate mentality of individuals towards agility as a suitable tool for proper adaptation to Agile practices has been emphasized in previous studies [45], [46]. The role of individuals is also critical in becoming and staying Agile. Individuals, as the key organizational elements in Agile development, can play a negative or positive role in Agile consolidation. In general, research findings show that if development team members, managers, and customers have a good understanding of Agile, they can be a very effective help in staying Agile. This has been emphasized in previous research [42], although no further details have been published. On the other hand, managers and people who are not committed to Agile will play a negative role in Agile consolidation. This has been particularly emphasized in previous studies [38], [47], [48].

Another important aspect in Agile consolidation is Agile organizational culture and the need to define and implement it. Part of the initial findings of this study is to define an Agile organizational structure and part is to implement such a culture. The Agile cultural structure should be derived from organizational values that are fully compatible with Agile values. It is also necessary for organizational culture to pay attention both to creating a mentality that is compatible with Agile and at the same time, to prioritize cultural change over changing processes. To implement the Agile culture, it is necessary to pay attention to the organizational structure and chart in accordance with the requirements of Agile, as well as to define the required incentives and punishments. Attention to Agile organizational culture and its role in team structure has been emphasized by researchers in several studies [46], [49], [50]. In particular, this issue should be considered in distributed and multi-site teams rather than small environments. Because in these environments, differences in personal culture can be a serious obstacle and Agile organizational culture can create an absolute rule in organizations [50], [51]. Another important point is to pay attention to the cultural shift and its priority to changing processes. This fact, in practice, is the basis of Agile transition and consolidation in organizations. This is especially important in multi-cultural environments [52], [53]. Overall, it seems that paying attention to the findings of this research in the real environment can help Agile teams and companies in Agile consolidation and provide them with a clear vision in this direction.

8. THREATS TO THE VALIDITY

In qualitative studies such as Grounded Theory, researchers are considered as one of the research risks. Because the researcher is a data collection tool, and any bias of the researcher can harm the collected data and ultimately on the results [34], [54]. In this study, the first author had little familiarity with the field under study and in all interviews, the interviewees were asked questions without any prejudice or mental presuppositions. Another issue that can threaten the credibility of qualitative research is the information and knowledge of the respondents [34]. In this study, to reduce this risk, individuals were selected selectively (not randomly) and their adequacy of knowledge and skills was ensured before interviewing them. However, during the interview, for more reassurance, questions were sometimes asked to check the interviewee's

knowledge. How to analyze the data and ensure the accuracy of the resulting code is another important factor in the validation of Grounded Theory-based research [34]. In this study, the resulting codes were created by the first author and reviewed by the second author and another expert to ensure their accuracy. In the present study, in addition to the above, other methods such as triangulation [55], participant checking [55], and Peer debriefers [56] have been used to validate the research and the results.

9. CONCLUSION

Agile transition is one of the goals of companies and software teams, and in this regard, several frameworks and models have been provided. But these models are only used for Agile transformation and not to consolidate it. There are problems in the path of this consolidation, some of which were mentioned in this study, such as personal issues, managerial and organizational issues, and structural and process issues are among the most important of these problems that make it difficult to consolidate Agile methods and practices in an organization. In order to be able to provide a framework or method for Agile consolidation, it is necessary to pay attention to the ambiguities and issues that are effective in this area which are effective factors on Agile consolidation, evaluation method, consolidation structure, or framework, and hierarchy. In fact, more efforts have been made to use and adopt Agile methodologies and transition to it. But little attention has been paid to the Agile institutionalization and the sustainability of its use. This research uses the grounded theory research method to try and provide a solution to Agile consolidation in newly Agile teams. Preliminary findings of this study show that Agile consolidation faces several problems and challenges, each of which plays a negative role. Also, the initial findings indicate several factors, each of which in some way facilitates and helps Agile consolidation. Also, personal factors affecting the Agile consolidation that play positive or negative roles are other findings of this study. Important features that should be considered in creating and establishing an Agile organizational culture were also identified.

REFERENCES

- [1] P. Abrahamsson, O. Salo, J. Ronkainen, and J. Warsta, "Agile software development methods: Review and analysis," *VTT Publications*, no. 478, pp. 3–107, Sep. 2002, doi: 10.48550/arxiv.1709.08439.
- [2] D. Turk, R. France, and B. Rumpe, "Assumptions underlying agile software-development processes," *Journal of Database Management*, vol. 16, no. 4, pp. 62–87, Oct. 2005, doi: 10.4018/jdm.2005100104.
- [3] G. T. G. Neto, W. B. Santos, R. A. A. Fagundes, and T. Margaria, "Towards an understanding of value creation in agile software development," *In Proceedings of the XV Brazilian Symposium on Information Systems*, May 2019, pp. 1-8, doi: 10.1145/3330204.3330256.
- [4] J. Bosch, "From efficiency to effectiveness: Delivering business value through software," in *Lecture Notes in Business Information Processing*, vol. 370 LNBIP, Springer International Publishing, 2019, pp. 3–10.
- [5] A. Cockburn and J. Highsmith, "Agile software development: The people factor," *Computer*, vol. 34, no. 11, pp. 131–133, 2001, doi: 10.1109/2.963450.
- [6] G. R. Simmons, A. Patrick and R. Calk "Hawkes learning company: the transition from traditional to agile governance," *Journal of Leadership, Accountability and Ethics*, vol. 16, no. 4, Nov. 2019, doi: 10.33423/jlae.v16i4.2367.
- [7] T. J. Gandomani and M. Z. Nafchi, "An empirically-developed framework for Agile transition and adoption: A Grounded Theory approach," *Journal of Systems and Software*, vol. 107, pp. 204–219, Sep. 2015, doi: 10.1016/j.jss.2015.06.006.
- [8] T. J. Gandomani and M. Z. Nafchi, "The essential prerequisites of agile transition and adoption: a grounded theory approach," *Journal of Internet Computing and Services*, vol. 17, no. 5, pp. 173–184, Oct. 2016, doi: 10.7472/jksii.2016.17.5.173.
- [9] T. J. Gandomani, H. Zulzalil, A. A. A. Ghani, A. B. Abu, and K. Y. Sharif, "An exploratory study on managing agile transition and adoption," in *Advances in Intelligent Systems and Computing*, vol. 265 AISC, Springer International Publishing, 2014, pp. 177–188.
- [10] T. J. Gandomani, H. Zulzalil, A. A. A. Ghani, A. B. Md. Sultan, and K. Yatim Shairf, "Exploring facilitators of transition and adoption to agile methods: a grounded theory study," *Journal of Software*, vol. 9, no. 7, Jul. 2014, doi: 10.4304/jsw.9.7.1666-1678.
- [11] T. J. Gandomani, H. Zulzalil, and M. Z. Nafchi, "Agile transformation: What is it about?," in *2014 8th Malaysian Software Engineering Conference, MySEC 2014*, Sep. 2014, pp. 240–245, doi: 10.1109/MySec.2014.6986021.
- [12] B. Boehm and R. Turner, "Rebalancing your organization's agility and discipline," in *Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, vol. 2753, Springer Berlin Heidelberg, 2003, pp. 1–8.
- [13] B. Boehm and R. Turner, "Balancing agility and discipline: Evaluating and integrating agile and plan-driven methods," in *Proceedings - International Conference on Software Engineering*, 2004, vol. 26, pp. 718–719, doi: 10.1109/icse.2004.1317503.
- [14] A. Sidky, J. Arthur, and S. Bohner, "A disciplined approach to adopting agile practices: The agile adoption framework," *Innovations in Systems and Software Engineering*, vol. 3, no. 3, pp. 203–216, Jul. 2007, doi: 10.1007/s11334-007-0026-z.
- [15] M. Jovanović, A. L. Mesquida, A. Mas, and B. Lalić, "Towards the development of a sequential framework for agile adoption," in *Communications in Computer and Information Science*, vol. 770, Springer International Publishing, 2017, pp. 30–42.
- [16] D. Leffingwell, *SAFe 4.5 reference guide: scaled Agile framework for lean enterprises*. 2011.
- [17] K. Conboy and N. Carroll, "Implementing large-scale agile frameworks: challenges and recommendations," *IEEE Software*, vol. 36, no. 2, pp. 44–50, Mar. 2019, doi: 10.1109/MS.2018.2884865.
- [18] A.-C. Fernstrom, "A framework for changing organizational culture for agile transformations: A Delphi study," *Dissertation Abstracts International Section A: Humanities and Social Sciences*, vol. 81, no. 5-A, 2020, Accessed: Mar. 23, 2022. [Online]. Available: <http://search.ebscohost.com/login.aspx?direct=true&db=psych&AN=2020-04053-023&camp%0Alang=de&site=ehost-live>.

- [19] M. Jovanovic, antoni L. Mesquida, antonia Mas, and R. Colomo-Palacios, "Agile transition and adoption frameworks, issues and factors: a systematic mapping," *IEEE Access*, vol. 8, pp. 15711–15735, 2020, doi: 10.1109/aACCESS.2020.2967839.
- [20] I. Ghani, A. Lim, M. Hasnain, I. Ghani, and M. I. Babar, "Challenges in distributed agile software development environment: A systematic literature review," *KSII Transactions on Internet and Information Systems*, vol. 13, no. 9, pp. 4555–4571, Sep. 2019, doi: 10.3837/tiis.2019.09.013.
- [21] A. Khalid, S. A. Butt, T. Jamal, and S. Gochhait, "Agile scrum issues at large-scale distributed projects: scrum project development at large," *International Journal of Software Innovation*, vol. 8, no. 2, pp. 85–94, Jan. 2020, doi: 10.4018/IJSI.2020040106.
- [22] T. J. Gandomani and M. Z. Nafchi, "Agile transition and adoption human-related challenges and issues: A Grounded Theory approach," *Computers in Human Behavior*, vol. 62, pp. 257–266, Sep. 2016, doi: 10.1016/j.chb.2016.04.009.
- [23] T. J. Gandomani, H. Zulzalil, A. A. A. Ghani, A. B. Abu, and R. M. Parizi, "The impact of inadequate and dysfunctional training on agile transformation process: A grounded theory study," *Information and Software Technology*, vol. 57, no. 1, pp. 295–309, Jan. 2015, doi: 10.1016/j.infsof.2014.05.011.
- [24] R. Hoda and J. Noble, "Becoming agile: a grounded theory of agile transitions in practice," in *Proceedings - 2017 IEEE/ACM 39th International Conference on Software Engineering, ICSE 2017*, May 2017, pp. 141–151, doi: 10.1109/ICSE.2017.21.
- [25] S. Thorgren and E. Caiman, "The role of psychological safety in implementing agile methods across cultures," *Research Technology Management*, vol. 62, no. 2, pp. 31–39, Mar. 2019, doi: 10.1080/08956308.2019.1563436.
- [26] F. Calefato and C. Ebert, "Agile collaboration for distributed teams [software technology]," *IEEE Software*, vol. 36, no. 1, pp. 72–78, Jan. 2019, doi: 10.1109/MS.2018.2874668.
- [27] J. M. Bass and A. Haxby, "Tailoring product ownership in large-scale agile projects: managing scale, distance, and governance," *IEEE Software*, vol. 36, no. 2, pp. 58–63, Mar. 2019, doi: 10.1109/MS.2018.2885524.
- [28] D. Smitte, N. B. Moe, G. Levinta, and M. Floryan, "Spotify Guilds: how to succeed with knowledge sharing in large-scale agile organizations," *IEEE Software*, vol. 36, no. 2, pp. 51–56, Mar. 2019, doi: 10.1109/MS.2018.2886178.
- [29] A. Karimi and T. J. Gandomani, "Software development effort estimation modeling using a combination of fuzzy-neural network and differential evolution algorithm," *International Journal of Electrical and Computer Engineering*, vol. 11, no. 1, pp. 707–715, Feb. 2021, doi: 10.11591/ijece.v11i1.pp707-715.
- [30] T. J. Gandomani, Z. Tavakoli, H. Zulzalil, and H. K. Farsani, "The role of project manager in agile software teams: a systematic literature review," *IEEE Access*, vol. 8, pp. 117109–117121, 2020, doi: 10.1109/ACCESS.2020.3004450.
- [31] M. Esteki, T. J. Gandomani, and H. K. Farsani, "A risk management framework for distributed scrum using prince2 methodology," *Bulletin of Electrical Engineering and Informatics*, vol. 9, no. 3, pp. 1299–1310, Jun. 2020, doi: 10.11591/eei.v9i3.1905.
- [32] M. Mousaei and T. J. Gandomani, "A new project risk management model based on Scrum framework and Prince2 methodology," *International Journal of Advanced Computer Science and Applications*, vol. 9, no. 4, pp. 442–449, 2018, doi: 10.14569/IJACSA.2018.090461.
- [33] M. Lambert, "Grounded theory," in *Practical Research Methods in Education*, Routledge, 2019, pp. 132–141.
- [34] B. G. Glaser and A. L. Strauss, "The discovery of grounded theory," in *The Discovery of Grounded Theory*, Routledge, 2019, pp. 1–18.
- [35] K. Charmaz and L. L. Belgrave, "Thinking about data with grounded theory," *Qualitative Inquiry*, vol. 25, no. 8, pp. 743–753, Nov. 2019, doi: 10.1177/1077800418809455.
- [36] B. G. Glaser, "Constructivist grounded theory?," *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research*, vol. 3, no. 3, Sep. 2002, doi: 10.17169/FQS-3.3.825.
- [37] H. Ayed, B. Vanderose, and N. Habra, "Agile cultural challenges in Europe and Asia: Insights from practitioners," in *Proceedings - 2017 IEEE/ACM 39th International Conference on Software Engineering: Software Engineering in Practice Track, ICSE-SEIP 2017*, May 2017, pp. 153–162, doi: 10.1109/ICSE-SEIP.2017.33.
- [38] R. M. Fontana and S. Marczak, "Characteristics and challenges of agile software development adoption in Brazilian government," *Journal of Technology Management and Innovation*, vol. 15, no. 2, pp. 3–10, Aug. 2020, doi: 10.4067/s0718-27242020000200003.
- [39] J. Patel and R. Poston, "Using social intelligence to overcome agile adoption challenges," *Journal of Computer Information Systems*, pp. 1–12, May 2021, doi: 10.1080/08874417.2021.1913670.
- [40] N. Govil, M. Saurakhia, P. Agnihotri, S. Shukla, and S. Agarwal, "Analyzing the behaviour of applying agile methodologies DevOps culture in e-commerce web application," in *Proceedings of the 4th International Conference on Trends in Electronics and Informatics, ICOEI 2020*, Jun. 2020, pp. 899–902, doi: 10.1109/ICOEI48184.2020.9142895.
- [41] C. Tam, E. J. da C. Moura, T. Oliveira, and J. Varajão, "The factors influencing the success of on-going agile software development projects," *International Journal of Project Management*, vol. 38, no. 3, pp. 165–176, Apr. 2020, doi: 10.1016/j.ijproman.2020.02.001.
- [42] T. J. Gandomani, H. Zulzalil, A. A. A. Ghani, A. B. M. Sultan, and K. Y. Sharif, "How human aspects impress Agile software development transition and adoption," *International Journal of Software Engineering and its Applications*, vol. 8, no. 1, pp. 129–148, Jan. 2014, doi: 10.14257/ijseia.2014.8.1.12.
- [43] A. (Arttu) Kärki, "The impact of education and training in large-scale agile transformation," 2020.
- [44] D. Venkatesh and M. Rakhra, "Agile adoption issues in large scale organizations: A review," *Materials Today: Proceedings*, Dec. 2020, doi: 10.1016/j.matpr.2020.11.308.
- [45] I. O. Mikhieieva, "Agile mindset competencies for project teams," Bilbao, 2020.
- [46] B. C. Robison, "Embracing Agile acquisition with an Agile mindset." Calhoun, 2020, [Online]. Available: <https://apps.dtic.mil/sti/citations/AD1114711>.
- [47] P. Patanakul and R. Rufo-McCarron, "Transitioning to agile software development: Lessons learned from a government-contracted program," *Journal of High Technology Management Research*, vol. 29, no. 2, pp. 181–192, Nov. 2018, doi: 10.1016/j.hitech.2018.10.002.
- [48] L. Khoza, C. Marnewick, and B. Hinson, "Critical challenges and benefits organisations face in the adoption of agile software methodologies," in *Pan-Pacific Conference: Innovation for Value Creation and Beyond*, May 2018, p. 136, [Online]. Available: <https://www.researchgate.net/publication/339271362>.
- [49] M. Faisal Abrar *et al.*, "De-motivators for the adoption of agile methodologies for large-scale software development teams: An SLR from management perspective," *Journal of Software: Evolution and Process*, vol. 32, no. 12, Jun. 2020, doi: 10.1002/smr.2268.

- [50] D. Šmite, J. Gonzalez-Huerta, and N. B. Moe, “‘When in Rome, do as the romans do’: cultural barriers to being agile in distributed teams,” in *Lecture Notes in Business Information Processing*, vol. 383 LNBIP, Springer International Publishing, 2020, pp. 145–161.
- [51] K. P. Jivan, A. L. Marnewick, and N. Joseph, “Influence of organizational culture in the adoption of agile,” *2020 IEEE Technology & Engineering Management Conference (TEMSCON)*, Jun. 2020, doi: 10.1109/TEMSCON47658.2020.9140091.
- [52] K. Wortman, B. Duncan, and E. Melin, “Agile methodology for spacecraft ground software development: A cultural shift,” *IEEE Aerospace Conference. IEEE*, Mar. 2017, doi: 10.1109/AERO.2017.7943886.
- [53] A. Putta, “Scaling agile software development to large and globally distributed large-scale organizations,” in *Proceedings - International Conference on Software Engineering*, May 2018, pp. 141–144, doi: 10.1145/3196369.3196386.
- [54] L. Creswell, John W. (University of Nebraska, “Research design: qualitative, quantitative and mixed methods approaches,” *Research Design Qualitative, Quantitative, and Mixed Methods Approaches*, pp. 153–227, 2013.
- [55] J. W. Creswell and D. L. Miller, “Determining validity in qualitative inquiry,” *Theory into Practice*, vol. 39, no. 3, pp. 124–130, Aug. 2000, doi: 10.1207/s15430421tip3903_2.
- [56] J. Creswell, “Design: choosing among five approaches,” *Design: Choosing Among Five Approaches*, vol. 3, no. June, p. 448, 2012.

BIOGRAPHIES OF AUTHORS



Tayebeh Mohamadi Gahroee     received a B.Sc. degree in computer engineering from the Islamic Azad University, Mobarakeh Branch in 1995, and a M.Sc. in computer engineering from the Islamic Azad University, Shahrekord Branch in 1994. She is currently a PhD student in software systems at the Islamic Azad University, Khorasgan Branch. She can be contacted at email: dr.mohamadi8435@gmail.com.



Taghi Javdani Gandomani, Senior Member, IEEE     received the Ph.D. degree from UPM, Malaysia in 2014. He is currently an Assistant Professor of Software Engineering at Shahrekord University, Iran. His research interests include Agile software development, software process improvement, software project management, and empirical software engineering. He is also the leader of the Data Science Research Center at Shahrekord University, Iran. He can be contacted at email: javdani@sku.ac.ir and javdani@ieee.org.



Mohammadreza Soltan Aghaei     received the B.Sc. degree in Computer Engineering from the Isfahan University of Technology, Iran, the M.Sc. degree in Artificial Intelligence and Robotic from Faculty of Computer Engineering and Information Technology, Shiraz University, Iran, and the Ph.D. in Quantum Networks and Algorithms from Faculty of Computer Science and Information Technology, UPM University of Malaysia in 2010. He used to hold several administrative posts with the Islamic Azad University of Isfahan from 2010 to 2022 including the Head of Department of Computer Engineering, the Deputy Dean of Postgraduate Studies in Faculty of Engineering, and the Head of Department of Computer Postgraduate Studies. He is also the Director of the Cyber Space Passive Defense Research Center since 2010. His research interests include Quantum algorithms and Computer Networks. He can be contacted at email: soltan@khuisf.ac.ir and msoltanaghahi@gmail.com.