



THE STATE OF THE ART OF AGILE KANBAN METHOD: CHALLENGES AND OPPORTUNITIES

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ABSTRACT

In the recent years, the Agile Kanban has emerged as an appropriate method used for managing projects in numerous fields and various settings. Despite getting an increased popularity in the software organizations, the Agile Kanban method still has different challenges that need to be addressed. Therefore, this study aims to concisely explore the current state of the art and latest researches on the Agile Kanban method through conducting an extensive review of the literature. The results of this study carry strong implications and confirm the important need for conducting researches on the Agile Kanban method. It also provides the key challenges and opportunities that can be investigated in future studies. The cross analysis of the results leads to a better understanding of the Agile Kanban method and aids the research teams to address the Kanban limitations and increase its adoption in the software organizations.

Keywords: Agile methods; Kanban method; software development; state of the art



1. INTRODUCTION

In today's era, the Agile methods are being the widely accepted approaches within different organizations due to their multiple benefits over the previously used traditional methods (Yazdanjooei & Khamseh, 2020; Alaidaros et al., 2019a). The common meaning of Agile is to 'move quickly and easily', thus using Agile methods make the work progresses easily and projects are delivered in a serialized process rather than delivering it at the completion (Varun & Karthika, 2020). The Global Project Management (2018) survey indicates that 71% of the participating organizations report greater agility over the last five years signifying that agility is recognized in helping them to remain competitive. Moreover, the 12th annual state of the Agile survey shows that most organizations (97%) practice Agile methods (Version One, 2018).

Scrum and Kanban are considered as the two powerful Agile methods that handle and manage the progress of software development (Alaidaros & Omar, 2017; Lei et al., 2017). These two methods have influence for different Agile team members and projects in diverse situations, as they can optimize the setting-up of the teams, identify the their tasks, and manage the development time efficiently (Yilmaz & O'Connor, 2016). According to Version One (2018) report, 56% of the respondents practice Scrum as compared to the other Agile methods. However, various studies conducted by Lei et al. (2017), Ahmad et al. (2018), Alaidaros (2020), and Shafiq et al. (2019) confirm that the Kanban method has achieved its popularity in the recent years as it embraces numerous advantages that help in improving the process of projects management.

Despite getting a wide acceptance in the software organizations, the Agile Kanban method still has different challenges face the software practitioners when implementing this method. To tackle this situation, this study employed the narrative review method to explore the relevant literature on the Agile Kanban method. The narrative review is a rigid systematic review method synthesizes a body of literature retrieved from various scientific sources in order to investigate a specific topic (Alaidaros et al., 2018a). In addition, a cross analysis was used to compare the results of the retrieved studies. In particular, this study attempts to answer the following research questions (RQs):

- **RQ1:** What are the current state of the art and latest researches on the Agile Kanban method?
- **RQ2:** What are the major challenges and opportunities of the Agile Kanban method?



- **RQ3:** How do we can increase the adoption of the Agile Kanban method?

In this paper, the three research questions are answered through reviewing and analyzing the related literature. Section 2 reviews the latest researches and studies conducted on the Agile Kanban method. After that, section 3 discusses the major challenges and opportunities of the Agile Kanban method. Section 4 presents directions for future researches which are aimed to increase the adoption of the Agile Kanban method. This study is summarized and concluded in the final section.

2. AGILE KANBAN METHOD

2.1. Background

The concept of Kanban has been introduced at Toyota in 1947, in which this term has originated from a Japanese term denoting ‘signboard’. It is a visual process management system that can manage knowledge and work by considering the Just In Time (JIT) delivery approach. The JIT does not overload team members since the Kanban method focuses on removing bottlenecks and waste, as well as reducing waiting times, which lead to the increase of the throughputs amount (Aurisch et al., 2019; Ikonen et al., 2011).

In 2004, David J. Anderson, anticipated the Kanban as a software development method. He is considered as the father of Kanban and one of the top leaders behind the movement. He described Kanban as “an approach to incremental, evolutionary process, and systems change for organizations” (Anderson, 2010). The Agile Kanban method can enhance the understanding, visibility, and controlling of the workflow. It can help the management by identifying the bottlenecks during the development process of software projects (Alaidaros et al., 2018b; Al-Baik & Miller, 2015). This method uses the pull system as the core approach in exposing the problems of system process and to stimulate collaboration for continuously improving the system (Anderson, 2010).

Agile Kanban is a key method used for managing workflow and controlling waste in developing software projects (Alaidaros et al., 2019b). The works in the traditional methods look like a chain, whereby the work of one member is given to another and thus may cause lags in the development cycle. For instance, if a member was to have problems related to the other member’s work, his or her tasks will become overloaded. However, rather than pushing the tasks to members, the Agile Kanban method utilizes the pulling system in which all members in a team must only have one task to work on at a specific time. Once completed the given task, team member can pull another task (Banijamali et al., 2017).



The adoption of the Agile Kanban method has increased sharply during the last three years (2015-2017) from 39% to 65% (Version One, 2017, Version One, 2018). This method has gaining an increasing popularity and attention by software practitioners due to its numerous benefits that make it performs better than other methods in terms of managing the development process of software projects (Lei et al., 2017; Ahmad et al., 2018; Alaidaros, 2020; Shafiq et al., 2019). Nevertheless, there are some studies contended that the Kanban method is still having several challenges make it a highly pertinent and worth exploring topic by the researchers and practitioners over the recent years as discussed in the next section. This section continues with presenting the Kanban principles and practices, follows by describing the Kanban board, and it ends with highlighting benefits of the Kanban method.

2.2. Kanban Principles and Practices

Anderson (2010) has defined five principles for the Agile Kanban method, which are: a) limiting work in progress (WIP), b) visualizing workflow, c) measuring and managing the flow, d) making process policies explicit, and e) using models to recognize improvement opportunities. These principles are briefly described.

- a) **Limiting WIP:** This is a core principle of the Agile Kanban method, which is defined as the maximum count of tasks for each Kanban board stage. It is commonly identified by project manager to prevent roadblocks and make tasks move quickly on the board.
- b) **Visualizing workflow:** This is another core principle of the Kanban method, which is defined as the process of highlighting the mechanisms, interactions, waiting, queues, and delays, which are involved in implementing a part of valuable software.
- c) **Measuring and managing the flow:** This principle of measuring and managing flow highlights a focus not only on keeping a work or task moving but also on the need of using the flow as the driver for improvement. The mastering is the focus on flow rather than on waste removal.
- d) **Making process policies explicit:** This principle reflects the effectiveness and reality of a work that needs to be well defined in order to give encouragement to all team members. This is important to ensure that all team members can think on the development process as a group of policies, instead of considering workflows as a restricted technique.
- e) **Using models to recognize improvement opportunities:** The Kanban method adopts the quantitative scientific approach to create improvements. The method focuses on the



models that lean towards managing waste and controlling flow by considering the Theory of Constraints (TOC). The method also tries to understand the system and variations of the profound knowledge.

Besides the principles, the Agile Kanban method has four practices, which are: (a) Start with what do you have, (b) Agree to pursue incremental and evolutionary change, (c) Respect the existing roles, processes, and responsibilities, and (d) Encourage the leadership acts during the whole development process (Flora & Chande, 2014).

Dingsøyr et al. (2019) also acknowledged that the Agile Kanban method is significantly differ from other methods because it starts with where an organization is, and does not require the creation of new roles, ceremonies, or structures before getting started. However, limiting the WIP and visualizing the workflow are the two core principles of the Agile Kanban method that are used for monitoring the project progress (Alaidaros et al., 2018b).

2.3. Kanban Board

The Agile Kanban method has a board that is used to visualize the workflow and monitor the project progress by showing the activities of the development process and keeping the WIP in control (Anderson, 2010). The Kanban board also provides the ability to concentrate on few tasks for the developers. Thus, resources and time waste would be reduced due the switching process between the tasks in Kanban board (Dennehy & Conboy, 2017). The Kanban board is the key aspect of the Agile Kanban method since the development process can be tracked (Saltz et al., 2017).

Typically, the Kanban board is vertically divided into different columns or stages. Each stage refers to the task state, while each task is represented by a card attached on the board in the stage to represent the current state of tasks (Nakazawa & Tanaka, 2016). On the Kanban board, cards are moved from left to the right side based on the changes of the task's state (Dennehy & Conboy, 2017).

The Kanban board has two types, which are simple and detailed boards. Usually, a project manager determines the type of Kanban board, either to be a simple or detailed board, based on a number of criteria such as the project size, number of tasks, and number of team members (Nakazawa & Tanaka, 2016). The simple Kanban board has three stages, which are To Do, Doing, and Done. Figure 1 shows a simple Kanban board.



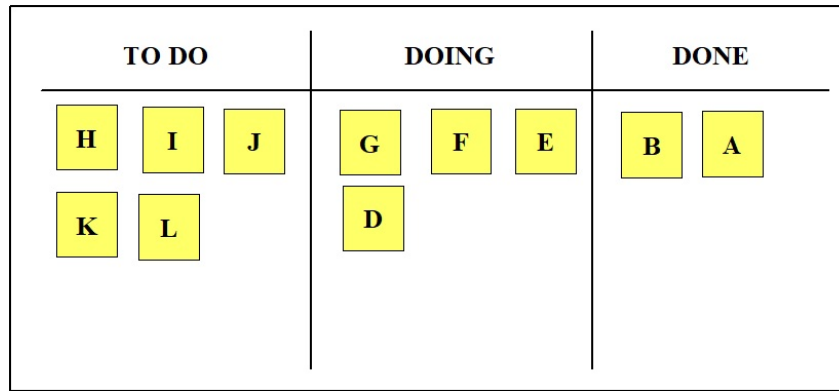


Figure 1: A simple Kanban board

However, the detailed Kanban board may have more and different stages. For instance, Backlog, Analysis, Development, Test, and Deployment or Done are stages of the detailed Kanban board as depicted in Figure 2.

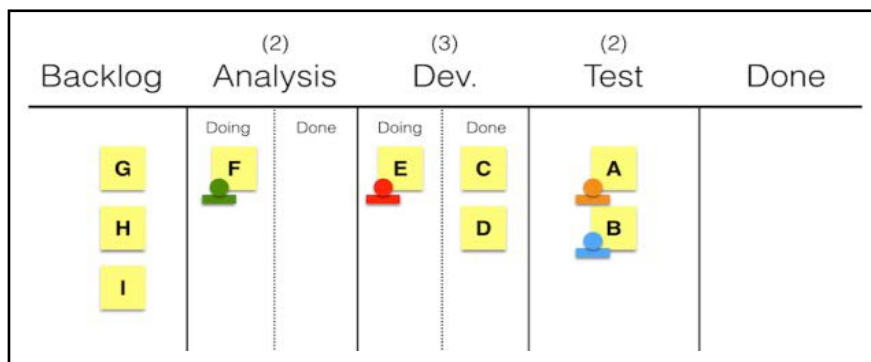


Figure 2: A detailed Kanban board (adopted from Dennehy and Conboy (2017))

According to Philbin (2017), there is a tendency of adopting the Kanban board in the software development organizations (SDOs) to support the transparent communications between all team members. This adoption facilitates the development process of the software projects since it is easier to understand and follow (Lindblom, 2015). Moreover, it enables team members to monitor the projects' progress through a property of limiting WIP for each stage (Dennehy & Conboy, 2017).

However, determining the numbers of the WIP limits for each stage in the Kanban board is proven to be a major challenge faced by the software project practitioners (Ahmad et al., 2016; Dennehy & Conboy, 2018; Tripp et al., 2018). Therefore, there is a greater need to generate the optimum numbers of WIP limits and identify the criteria that influenced the setting up of these limits.

A case study was conducted by Lisi Romano and Delgado Da Silva (2015) to tackle the use of the Scrum method within a small SDO. The development team has acknowledged that the adoption of the Kanban board within their organization helps to easily observe and track

the running of projects' tasks compared to the previous one, in which it was not visible by everyone involved. In addition, the Kanban board can demonstrate the success of stakeholders, whereby they can see, understand, monitor progress status of a project (Al-Baik et al., 2017).

Nevertheless, the visualization of the Kanban board is limited to show the development process activities rather than providing sufficient information or useful indications that could help in monitoring the project progress (Aurisch et al., 2019; Alaidaros et al., 2018b). Therefore, there is an imperative need to identify alternative visualization criteria for improving the Kanban method that can provide useful insights in reporting the projects' status.

2.4. Kanban Benefits

This section identifies and explains the benefits of the Agile Kanban method retrieved from reviewing the literature. During the development process, this method uses the Kanban board to visualize the project workflow. In the Kanban board, the WIP is limited by the project managers to assist them in monitoring the progress and make the team members focusing on only one task at a specific time (Al-Baik & Miller, 2015).

Ahmad et al. (2014) pointed out that this Kanban method has better visibility and understanding of the whole development process as well as effective controlling of the workflows and WIP limits. Yacoub et al. (2016) also admitted that Agile Kanban is a flexible, responsive, and reliable method. Besides that, Mirza and Datta (2019) stated that the Agile Kanban method can improve the communication and work transparency, customer satisfaction, and team coordination among different stakeholders. Furthermore, Ikonen et al. (2011) argued that the Kanban method not only helps to motivate team members but also supports project managers in monitoring all project activities during the development process of software projects.

In comparing with Scrum, Ahmad et al. (2018) affirm that the adoption of Kanban method is continuously on the rise within the SDOs as it performs better than Scrum and other Agile methods. The attractiveness of Kanban is also confirmed by Shafiq et al. (2019) who indicate that Agile practitioners are currently shifting towards Kanban method due to its effective communication facilitation, transparency, and limited WIP traits. As for Guckenheimer and Loje (2012), Kanban allows continuous adjustment, while Scrum relies on team commitment, reviewed at sprint boundaries. In Scrum, the communication focus is verbal, while in Kanban is visual through the use of Kanban board even though it is an overcomplicated board (Aurisch et al., 2019).



In addition, instead of using iterations as in the Scrum, the Kanban method maximizes the workflow, minimizes the lead-time, and delivers software continuously (Flora & Chande, 2014). A study conducted by Sjøberg et al. (2012) to compare the use of Scrum and Kanban methods across a period of two years. The results revealed that the replacement of Scrum by the Kanban method in SDOs can reduce the lead-time by 50%, minimize the number of bugs by 11%, and improve the software productivity by 21%. They also notified that the Kanban method is not only able to remove periodic wastes, as a result of the rigidity of Scrum time-boxing and Scrum meetings, but is also able to maintain the whole benefits of the Agile methods.

Surprisingly, the Kanban was found to be much more effective than the Scrum method. Lei et al. (2017) conducted a study to examine the differences between Scrum and Kanban methods through a group of six factors, which have an influence on the development process of software projects. Statistically, results showed that there is no crucial difference between these two methods pertaining to the six factors. However, the numerous advantages enable Kanban to perform better than the Scrum method in managing software projects. Projects that apply the Kanban method could also experience greater consistency in projects management.

From the above discussion and comparison, it can be concluded that Kanban is the best method amongst the other Agile methods because it embraces various characteristics, particularly from the management perspective of the software projects. Despite of having several advantages, the Agile Kanban method still have challenges require further investigations as explained subsequently.

3. CHALLENGES AND OPPORTUNITIES

In a recent study conducted by Zayat and Senvar (2020), it affirms that Agile Kanban is a simple method performed and can be quite efficient when supplemented by another improvement methods. Likewise, different studies claim that this method must be complemented with other methods to ensure high performance among the team members, as it is a relatively basic method (Ahmad et al., 2018; Dennehy & Conboy, 2017; Vital et al., 2019).

With this in mind, a number of studies were therefore conducted to address that issue by combine Kanban with other methods. For instance, a new method known as Scrumban was created by integrating Kanban and Scrum methods (Ladas, 2009). Yet, Scrumban still embraces the limitations of the Kanban method, such as the difficulty of setting the WIP limits (Ahmad



et al., 2016; Dennehy & Conboy, 2018) and the lacks of visualizing useful information concerning projects' progress (Aurisch et al., 2019; Alaidaros et al., 2018b).

Moreover, the Kanban method has been combined with a Value Stream Mapping (VSM) (Raju & Krishnegowda, 2014). However, this combination only focuses on improving some areas of VSM rather than Kanban that really requires a supporting method (Ali et al., 2015). Furthermore, Scrum, Kanban, and Lean methods have been integrated to overcome their weaknesses and combine their strengths together. Such integration is known as L-ScrumBan with validation rate of 93% that emphasizes on efficiency. Nonetheless, the L-ScrumBan does not focus and describe on the setting of the WIP limits on the board, which represents the essential principal of the Kanban method (Albarqi & Qureshi, 2018).

As illustrated above, it is clear that the previous studies, conducted to address the above-mentioned issue, are still have own limitations in addition to the key challenges of the Agile Kanban method which still persist. Therefore, there is a highly need to find a suitable method to support the efficiency of Kanban. Alaidaros and Omar (2017) reviewed the approaches used for managing the software projects as well as monitoring its progress. Authors suggested to integrate Kanban with Earned Value Analysis (EVA) method, as the former is an efficient and most widely used method for progress monitoring in the developing software projects (Ong et al., 2016). Hence, integrating the Agile Kanban with EVA method can make the most of both by considering their limitations (Alaidaros & Omar, 2017).

Al-Baik and Miller (2015) and Flora and Chande (2014) pointed out that the use of the Agile Kanban method in software engineering domain is still in its initial phases. Thus, a standard definition for software development and its specific practices are not yet rigorously defined. Nevertheless, this claim has been recently affirmed by Ahmad et al. (2018) and Mirza and Datta (2019) who indicate that there is a very limited researches that are able to provide guidelines pertaining to the Kanban implementation to the software practitioners. Thus, further researches are required to focus on exploring the Agile Kanban as it is a worthy method to be investigated.

Other challenges of adopting Kanban method include organizational culture, lack of specialized skills and training, being attached to familiar methods, and motivating team members (Ahmad et al., 2014). Matthew (2017) mentioned that the Kanban method is only suitable for teams that have members with overlapping skills, whereby everyone can pitch in



and help move the backlog list to zero. That is, in case of that only one of the team members has a certain in-demand skill, the individual can hold up everything.

A study conducted by Flora and Chande (2014) has identified two limitations of Kanban method. Firstly, a small breakdown in the development process of Kanban method can cause shutting down for the whole process and extra efforts are required to perform the recovery process. Secondly, instead of managing the throughput of the Kanban method, it is generated through controlling WIP and knowing cycle time. However, the setting of the WIP limits is a major challenge faces the software practitioners since the limits need to be adjusted from time to time (Ahmad et al., 2016; Dennehy & Conboy, 2018; Tripp et al., 2018). This challenge has confirmed by a study conducted by Alaidaros et al. (2018b), who state that the difficulty of identifying the WIP limits in Kanban method leads to the lags in the scheduling of the development process of software projects. Consequently, the authors claim to identify the criteria that influence the setting up of WIP limits in order to generate the optimum numbers of these limits.

In addition, the Kanban method has a challenge concerns with the visualization process via the Kanban board. Aurisch et al. (2019) affirmed that the Kanban board is still complicated when used in visualizing the project status. The complication is due to the inability of the Kanban board to neither display indications of the project's progress nor show quantitative information about the workflow progress. Such information is essentially needed for the project managers which would help them in terms of making meaningful decisions regarding the progress of project development (Dennehy & Conboy, 2018). In this regard, Alaidaros et al. (2018b) assert the challenge of Kanban method that represents in displaying insufficient information via Kanban board which would hinder the effective management of software project development. Hence, the authors contend to identify alternative visualization criteria in order to improve the effectiveness of visualization aspect of the Agile Kanban method.

4. FINDINGS AND FUTURE DIRECTIONS

We did a cross analysis which focused on exploring the major challenges of the Agile Kanban method from the retrieved studies. Additionally, we have identified its key opportunities obtained through the analysis that would be investigated in future works.

Although the Agile Kanban method was initially used in manufacturing domain; however, its adoption starts growing in other areas and different environments. For example, Kanban method has been used in different fields, such as sports science (Santirojanakul, 2018),



learning (Fitriawati & Lestari, 2019), big data science (Saltz & Shamshurin, 2019), Internet of Things (IoT) (Kurita et al., 2020), software project management (Omar et al., 2020), and students' projects (Shamshurin & Saltz, 2019).

Alaidaros et al. (2019c) developed a prototype tool for managing software development projects based on Kanban method. It was aimed to enhance the current features of existing tools and overcome their obstacles and limitations. This tool has been successfully evaluated through interviewing seven software practitioners from different companies in Malaysia. One of the participants suggested applying this tool in simple projects and small teams for educational purposes.

This evidenced by a recent study conducted by Mahnič (2019) who recommended universities must find a way to integrate Kanban method into their software engineering courses in order to meet industry needs. The study also indicated that universities are becoming aware of the importance of teaching the Kanban method and have started to follow the trends in the industry. Therefore, it is notable that universities recently started investigating the importance of the Agile Kanban method, whereby the focus of their research activities is leading to the method trends and applications in the industry.

From the analysis of findings, it was found that several challenges must be overcome in order to intensify the adoption of the Agile Kanban method in organizations, specifically in the software houses. Academic researches and practitioners' skills and efforts, together with organizations' cooperation are required to overcome these challenges. Therefore, the major findings of this study, that need to be addressed in future researches, are highlighted in the following points:

- The Agile Kanban needs to be explored and understood more thoroughly, especially factors affecting its success in managing different projects.
- Work should be done to develop a new approach integrates Kanban and EVA methods in order to yield an efficient and effective method for managing projects.
- There is a highly need to identify the criteria that influence generating the optimum numbers of WIP limits of Kanban board.
- Efforts should be made on the determination of alternative visualization criteria in order to improve the effectiveness of displaying aspect of the Agile Kanban method.



- Current researches claim that there is an urgent need to apply the concept and applications of the Agile Kanban method in the software development of students' projects in the universities and other academic institutions.

5. CONCLUSION

This study reviewed the present state of the art and latest researches done on the Agile Kanban method. The narrative review method was employed to explore the related literature from numerous scientific sources. The relevant studies were retrieved from the revision of the journals, proceeding papers, books, blogs, documents, and reports.

This study contributes a research review on the Agile Kanban method that is useful for the academic researchers and practitioners from different fields, which in turn significantly contributes to the body of knowledge. Specifically, this study provided an overview on Kanban history, and described its principles and practices. Then, it explained the Kanban board together with highlighting the advantages and benefits of Kanban method.

Although the Kanban board has been extremely used with Scrum method; however, it is affirmed the highly need for enhancing the visualization elements of that board. Finally, this study also discussed the main challenges of the method, and then summarized the existing opportunities for future works. Overall, the study findings confirm the highly need for conducting further researches concerning with the Agile Kanban method.

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