A Window into the Emergence of Agile Software Development Landscape in Indonesia

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Abstract

   Since the introduction of the Agile Manifesto over a decade ago, software industries around the world have started to change their software development process from traditional to Agile methods. A number of research studies conducted in Asia Pacific countries such as Malaysia, India, and New Zealand have provided valuable insight into Agile adoption and practice in these countries. However, very little is known about the state of Agile adoption in Indonesia. This study aims to investigate the adoption of Agile methods among 21 software practitioners in Indonesia using survey method. This includes the perceptions and level of awareness in using Agile methods as well as the challenges in adopting these methods. We found that major challenges revolved around the people, organizational and customer related issues. Findings from this study can be used as evidence about Agile adoption and practice in Indonesia and as a roadmap for future Agile-focused research studies.

   Keywords: *Agile Software Development, Agile Adoption, Awareness, challenges, Indonesia*

1   Introduction

In recent years, software developers have started to adopt Agile method for software development. Agile methodology has been adopted in many software development projects due to its ability to better cope with frequent changes in requirements. While traditional methodologies continue to dominate the systems development arena, numerous opinions and surveys clearly demonstrate the growing popularity of Agile methodologies [5][25][31]. A survey conducted by Ambler [5] in 2006 found that 41% from a total 4232 respondents worldwide have adopted Agile methodologies. The following year (2007), Ambler survey showed high success rate in using Agile, as 77% from 781 respondents indicated that 75% or more of their Agile projects were successful [6]. In 2008, an online poll conducted by MethodsAndTools.com [23], indicated that 56% of the 512 participants had adopted Agile. From here, data have shown that the adoption of Agile is increasing and have delivered positive results to the adopters.

Agile methodology encourages the developer team to meet with the customers in regular basis in order to verify and validate their requirements. Such a high collaborative environment will eventually lead for better quality and on-scheduled delivery by the end of project [26]. Nevertheless, recent study had exposed several weaknesses in Agile development process [32]. Some of the common weaknesses are its inability to survive in large and complex system, inability to develop safe-critical system, and inability to survive in distributed development environment [32][28].

Asnawi et al. [8] reported in their study that the use of Agile is still emerging in Malaysia. They have identified several benefits in adopting Agile practices by practitioners in Malaysia, although some challenges were also uncovered. Their findings indicated that Agile practices are easy to learn but difficult to be put into practice or implemented. Cooperation from each member of the team and support from higher management were found essential for the smooth implementation of Agile in Malaysia [8].

Our study attempts to capture the perception of Agile methods among software practitioners in Indonesia. Our study also aims to identify challenges in adopting Agile practices into a business process by IT professionals. In this research, the following questions were addressed to investigate the use of Agile in Indonesia:

- To what extents have Agile methods emerges amongst practitioners in Indonesia?

- What are the perceived benefits in adopting Agile into their business process?

- What are the challenges faced by IT professionals in Indonesia when adopting Agile in their company?

This study will contribute to the body of knowledge of Agile's adoption in South East Asia region. It ascertains the level of knowledge about Agile methods from the perspective of software development and project management amongst IT professionals in Indonesia.

This paper is organized as follows: Section II describes the background of our study including related work. Section III reports the research design followed by presentation of results from the survey in Section IV. Section V discussed the findings and finally Section VI concludes this study.

2   Background and Related Work

2.1 Agile Principles and Methods

Agile principles encourage practices that accommodate change in requirements at any stages of the development process [14]. Another principle of Agile methods, as mentioned by Paetsch et al. [26], is that customers are actively involved in the development process, facilitating feedback and reflection that can lead to more satisfying outcomes. These principles are guidelines for delivering high-quality software by the completion of project.

In general, Agile software development is categorized into the following elements: *incremental*, *cooperative*, *straightforward*, and *adaptive* [1]. By embracing these essentials categories of Agile, several techniques or methods of Agile have been introduced. Some of them are: *Extreme Programming [10], Scrum [29], Feature Driven Development (FDD) [27], Crystal Clear [10],* and *Agile Modeling* [1].

Extreme Programming (XP) aims at enabling successful software development despite undefined or constantly changing of software requirements. Some of the major characteristics of XP are short iterations with small releases and rapid feedback, close customer involvement, constant communication, continuous integration and testing, and pair-programming [2][10].

Scrum is an empirical approach that is based on elements of flexibility, adaptability, and productivity [29]. During the implementation process, Scrum grants sense of freedom for the developers to choose a particular software development technique, methods, and practices [29]. Scrum process includes three phases: pre-game, development, and post-game [29].

Agile Modeling (AM) encourages developers to produce sufficiently advanced model to support acute design needs and documentation purposes. The aim is to keep the amount of model and documentation as low as possible [1][2].Some of the values behind AM are: communication, simplicity, feedback, and courage[1].

Feature Drive Development (FDD) emphasizes quality aspects throughout the development process and includes frequent and tangible deliveries, along with accurate monitoring of the project progress [2]. FDD consists of five sequential processes during designing and building of the system, these processes namely: develop an overall model, build a feature list, plan by feature, design by feature, and build by feature [1]. The iterative processes of FDD-design and build- support quick adjustments to late changes in requirements and business needs [1].

Crystal Clear is considered a lightweight version of XP. It emphasizes on people rather than processes and requires three properties: frequent delivery, reflective improvement, and Osmotic Communication. [11].

Nerur et al. [25] mentioned that system development in the traditional approach is controlled by a life cycle model such as the waterfall model, spiral model, or even variations of these. These life cycles specifies the chores to be performed and the desired outcomes of each phase, and entrust roles to individuals who will perform these tasks [25]. Unlike traditional methods, Agile methods deal with unpredictability by relying on people and their creativity rather than process [13]. They are characterized by short iterative cycles of development driven by product features, periods of reflection and introspection, collaborative decision making, incorporation of rapid feedback and change, and continuous integration of code changes into the system under development [12].

Additionally, Paetsch et al. [26] in agreement with Cockburn & Highsmith [13] mentioned in their study that Agile methodologies were adaptive rather than predictive. As they noted, in traditional methods most of the software process is planned early during project planning where typically it involves a longer time frame. This method works well if there are no major changes in the plan and both the application domain and software technologies are well understood by the development team.

In contrast, Agile methods were developed to adapt and thrive on frequent changes, exhibit high variability in tasks, and in technology being used [18]. Paetsch et al. [26] added that Agile methods are people-oriented rather than process-oriented. It relies on people's expertise, competency, and direct collaboration rather than a rigorous, document-centric to produce high-quality software. Since Agile methods became rapidly popular in software industries, the number of research studies conducted on different aspects of Agile has increased. These include studies that focus on Agile adoption and their practice in real-world settings.

2.1 Advancement of Agile Software Methods

Since the introduction of the Agile Manifesto [4] in 2001, Agile methods and practices have gained immense popularity amongst software practitioners and researchers. Research community has focused their attention on the issues related

to Agile software development [14]. In particular, there is a notably keen interest displayed in this area of research based on the number of scientific publications, the topic of interest in various scientific forums, and the number of countries that have been involved in Agile research [14].

Empirical studies and research have been conducted in many countries throughout the years to support the implementations of Agile in the real-world settings. Dyba et al. [15] found a growing number of papers published on Agile software development from 1999 until 2003. There were over 180 papers about Agile in 2003, of which about one third of Agile papers contained empirical studies [15]. In a more recent study, Dingsoyr et al. [14] reported that they have identified a total of 1551 research papers published between 2001 and 2010 related to Agile software development.

Shine Technologies [31] conducted a web-based survey to ascertain organizations' interested in Agile methods. They received 131 respondents from all over the world where the majority of them (84.7%) indicated that they have knowledge about Agile development. The survey's results shows that XP was the most popular Agile method with 59% of respondents. A majority of respondents (80% or above) expressed that Agile processes had improved team productivity, business satisfaction, and the quality of product.

MethodsandTools.com [23] had done a similar online survey, gaining responses from 232 individuals. The results showed that nearly 40% of the respondents had adopted Agile methods and other 20% were evaluating them in pilot projects. Surveys at a larger scale have been conducted by Ambler [5], involving 4232 respondents. The survey's findings showed that 41% of the respondents had adopted Agile methods in their organizations, while 46% of the respondents have a sufficient knowledge about Agile methods. Almost half of the respondents (41% or above) stated that Agile methods had improved stakeholder's satisfaction, quality of the systems deployed, and productivity [5].

Given the increasing number of software practitioners who are aware of and implementing Agile methods around the world, some recent studies have focused on South East Asian countries. Asnawi et al. [8] conducted a focused and centralized study on the emergences of Agile methods in Malaysia. They performed interviews in seven software organizations, involving 14 software practitioners and investigated their perceptions towards Agile methods. Their findings showed that the use of Agile was still emerging, and that there is a lack of awareness about Agile in the government sector. Although several challenges have been found, the benefits of Agile practices such as involvement from all parties from the beginning, daily stand-up meeting and continuous integration were also reported. In addition, factors and difficulties faced by the early Agile adopters were also identified [8].

In Thailand, Morien and Tetiwat [24] conducted a study of Agile software development adoption in universities in Thailand. They conducted interviews

among 12 universities, including 5 top IT universities. The findings showed that Thai academics had little to no knowledge or understanding about Agile software development. They also discovered that topics on Agile methodology are not included in University curriculum in general. Ultimately, they concluded that lack of reading and learning material on Agile in Thai language as a major constraint.

Meanwhile in Indonesia, there is a clear lack of research in the area of Agile methods. We found only one study [20] conducted a case study that aimed to develop a collaborative model of software development that met the schedule, budget, scope and quality constraints according to the collaboration concept in Agile methods. This study, however, did not look at how Agile methods were being used or adopted in software development activities. The acute lack of studies on the use of Agile methods in Indonesia despite the sizeable software industry in Indonesia has motivated us to conduct the present study. Our study is one of the first to investigate the emergence of Agile methods in Indonesia and to explore the benefits and challenges of adopting Agile practices.

3 Research Methodology

We identified potential online group discussion relating to project management or software development for recruiting participants in this study. Participants involved consist of IT professionals, who work in Indonesia, and in particular working in software development industries. The participants were selected based on purposive sampling and came from various companies or organizations spread across various cities in Indonesia.

In this study, data was collected through online questionnaire where the members of online group discussion were invited to participate in the survey through emails and a message posted to a discussion thread. The online groups chosen were groups that have been created for Indonesian IT professional. The questionnaire contains both close-ended and open-ended questions and the questions were adopted from existing studies that focused on Agile methodology's adoption [5][23][31]. The survey was placed online for four (4) weeks and it was conducted in English.

Questionnaire survey was used in this study because it is a method for specifically gathering information about the characteristics, behavior, and attitudes of a population by administering a standardized set of questions [22]. Online survey was chosen due to a geographical constraint between the researcher and respondents. The questionnaire survey was answered by participants from a range of different roles who were involved or had knowledge about Agile processes to ensure that we had better edge and wider perspective of how Agile methodologies spreads among software developers in Indonesia. Particularly, this group consists of Agile Coaches, Developers, Designers, Business Analyst, and Senior Management. In order to answer the research questions addressed in this study, our variables of inquiry were the level of awareness on Agile, the perceived

benefits and their perception towards Agile in terms of challenges they faced in adopting Agile.

An open-ended question was given to allow participants to craft their own responses, which may lead respondents to express their own experiences freely. As a result, respondents' authentic viewpoints may be better represented in the findings and results [22]. In the open-ended question, the respondents were asked to state the challenges they faced in adopting Agile practices.

Before the questionnaire was made available to potential respondents, a pilot-testing was conducted among a small group of voluntary software practitioners in Indonesia. The aims of the pilot testing are to validate the question, whether it contains any ambiguous questions, and to ensure that no respondents were confused with the layout of the survey. A number of refinements were made to the survey content and presentation prior to actual data collection. Results acquired through the online survey were then analyzed using Statistical Package for Social Science (SPSS) version 20 for Windows.

4   Results

In this section, we present our result and analysis based on the data obtained from the online survey. The result and analysis of the online survey are divided into three parts. First, it describes the awareness of software practitioners in Indonesia towards Agile methods. Second it depicts perceptions from practitioners including perceived benefits of Agile based on the open-ended question in the survey. Lastly, it reflects obstacles on Agile implementations in software industries in Indonesia.

A total 100 IT professionals have been invited to participate in the study, however only 32 responded. Of the 32 respondents who answered the survey, 65% were software practitioners with more than five years work experience, 18.8% have worked less than a year, and the remaining have worked between three to five years and one to three years (9.4% and 6.3% respectively).

4.1 Awareness and Utilization of Agile Methods in Indonesia

Three questions were given to gather respondents' feedback on Agile awareness and utilization in Indonesia. Figure 1 provides summary of the Agile awareness, Agile utilization, and respondent's willingness to learn more about agile.

Of the total 32 respondents, 28 (87.5%) claimed that they have heard of Agile methodologies. The rest of the respondents said that they have never known or heard of Agile. Meanwhile, only 21 out of 32 respondents (65.6%) had actually used Agile at least once. Therefore, only these responses were

considered valid and will be included in our analysis. On the other hand, a total of 27 respondents (84.4%) admit that they are willing to learn more about Agile.
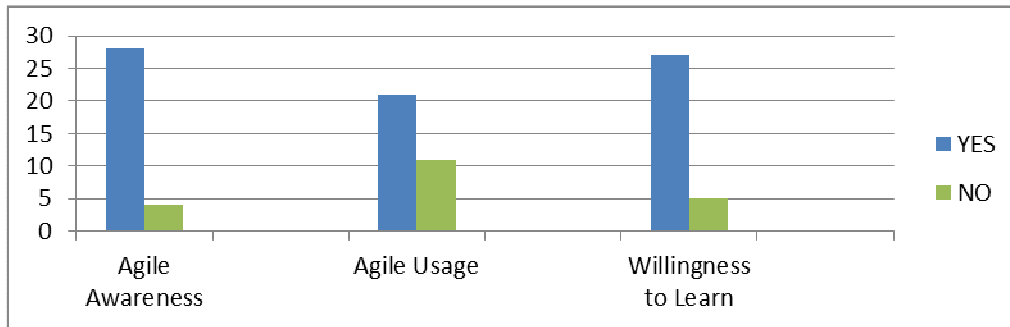

Fig. 1: Agile Awareness, Usage, and Willingness to Learn

Figure 2 depicts the cross-tabulation data between respondent's experiences with Agile awareness, use of Agile, and their willingness to learn Agile. Our data showed that respondents with lower level of expertise were less likely to be aware of Agile software development rather than those who have been working for longer time, typically more than a year.
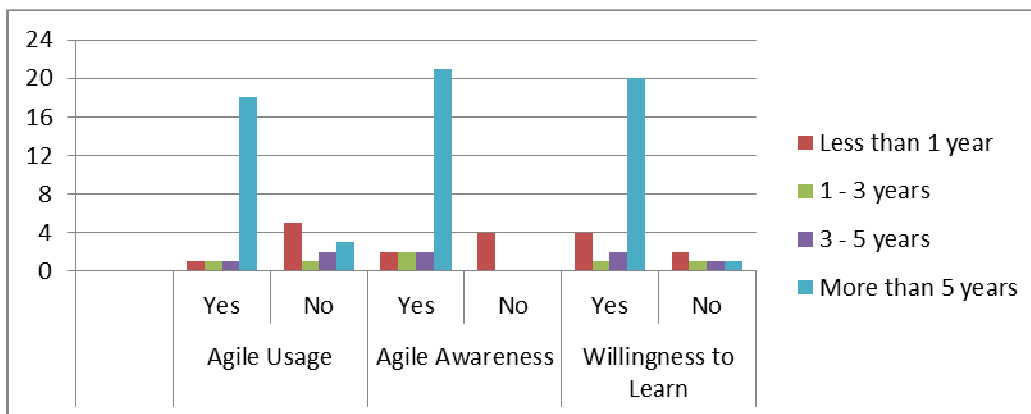

Fig. 2: Agile Awareness and Utilization based on Level of Expertise

Similarly, experienced practitioners have greater opportunity to encounter Agile methodology rather than the newcomers. Most of respondents with experiences for more than a year had applied Agile practices during some part of their career. Interestingly, even though most respondents had experience and knowledge of Agile, almost all of them showed no hesitation when asked whether they are willing to spend more time to master Agile practices. Only a small portion (i.e. 5 respondents) stated that they have no interest in learning Agile methodology.

4.2 Perceptions towards Agile

We have gathered data on the level of knowledge or perceptions towards Agile. Based on our data, we found that 21 out of 32 respondents have used Agile. Majority of those who have practiced Agile (13 out of 21, 62%) claimed that they have an average understanding of Agile methodologies. Only 6 out of 21 respondents (29%) perceived that they have extensive knowledge about Agile. We also found that regardless of the level of knowledge in Agile, majority of the respondents (18 out 21, 86%) have worked in their field for more than five (5) years. By far the most popular form of Agile processes used is Scrum (see Table 1). Scrum has been used by 15 out of 21 respondents (71.4 %) whereas XP is the second most used Agile technique which has been practiced by 6 out of 21 respondents (28.6%).

Table 1: Experience, Knowledge Level, and Agile Practices

Work Experience	Knowledge Level			Agile Practices	
	Extensive	Average	Limited	Scrum	XP
Less than a year	0	1	0	1	-
1 - 3 years	0	1	0	1	-
3 - 5 years	0	0	1	1	-
More than 5 years	6	11	1	12	6

We also gathered data on the effects of carrying out Agile methodologies in business process. We measured factors such as quality of application, productivity of developer team, cost of development and business satisfaction. Seventeen (17) out of 21 respondents (81%) perceived that adoption of Agile methodologies has made quality of their application better or significantly better. None of the respondents believe that Agile will reduce the quality of their application. Nevertheless, 9.5% of them consider Agile has made no changed to the quality (see Figure 3).

Adoption of Agile process had also shown a significant effect on the productivity of Agile team. Of 21 respondents, 15 (71.4%) claimed better productivity while 2 respondents (9.5%) claimed significantly better productivity. There were two contrasting opinion whether implementation of Agile process could reduce the development cost. Ten (10) out of 21 respondents (47.6) believed that Agile helps on cost-saving, whereas 9 out of 21 respondents considered no changes in their development cost. Lastly, 17 out of 21 respondents (81%) believed that utilization of Agile processes had made business satisfaction better or significantly better.
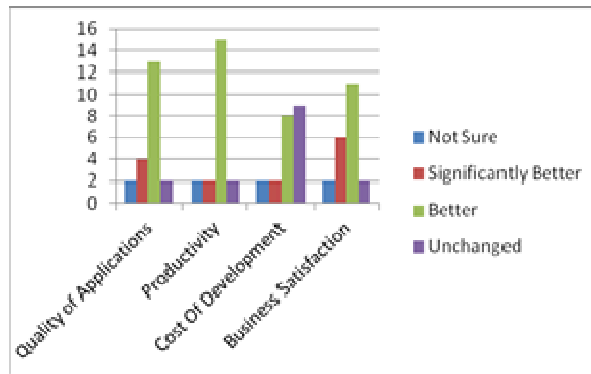
Fig. 3: Impacts of Implementing Agile Practices

In terms of the relationship between Agile practice and its impact on projects, we found that both Agile practices used by respondents (XP and Scrum) had better or significantly better impact on the quality of application, productivity, and business satisfaction. Five (5) out of six (6) XP users (83.3%) reported that their projects had at least improved both the quality of applications and productivity. We received the same result from 12 of 15 (80%) adopters. Meanwhile, in terms of impact on cost of development, nearly half of the respondents reported that there was no change when using either XP or Scrum. Participants were also of the view that business satisfaction from customers was guaranteed by adopting either methods. Our data shows that, Agile processes have largely been perceived positively by software professionals in Indonesia.

Based on the survey results, we found that the most positive features of Agile process were "People over process" with 71.4% (15 out of 21 respondents) followed by "Respond to change over Planning" with 19% (4 out of 21) (see Figure 4). This admiration of people-centric, responsive model is a dramatic change from traditional methodologies that value plans and processes.
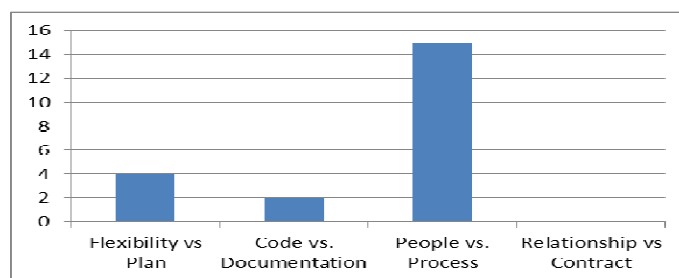

Fig. 4: Good Features of Agile

We also gathered respondent's perception on negative features or weaknesses of Agile. One interesting point to note is that although people-centric approach was listed as positive, lack of documentation is listed as the biggest concern with 47.6%. Similarly, although responsive and dynamic approach was selected as a

positive feature, the lack of planning was listed as the second highest concern with 33.3% responses (see Figure 5).
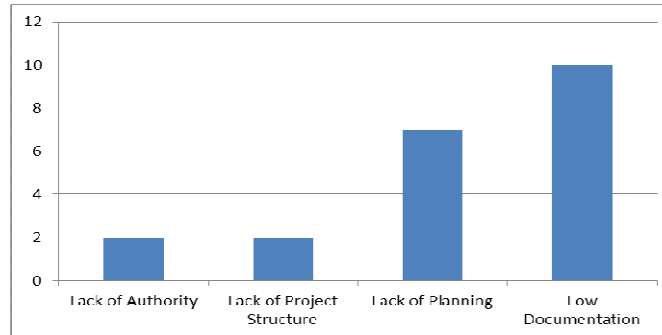

Fig. 5: Rating of Negative Features of Agile

4.2 Perceptions towards Agile

From a total number of 21 respondents who have been using Agile methods, we received qualitative feedback from 10 respondents in regard to challenges that they were facing in adopting or in using Agile practices in Indonesia. For analysis purposes, we could classify these challenges into two factors: *internal factor* and *external factor*. Internal factors relate to issue(s) that comes from within the Agile team, while external factors come from outside of the team.

4.2.1 Internal Factors

One of the major differences between traditional methodology and Agile methodology is that Agile methodology relies more on people – the team members deciding critical success factor on projects is the capability of each team member to have a special trait known as self-organizing [19]. Self-organizing in this context is the ability to handle and manage their affairs. Agile teams that are provided high degree of freedom by their senior management to organize and commit to a team goal tend to be self-organizing. High degrees of self-organization are strongly related to better team morale, customer collaboration, and ability to analyze and resolve complex business needs.

As a self-organizing team, each team member needs to have the ability to self-assign, self-commit, self-manage, self-evaluate, and self-improve [19]. These attributes are rarely applicable in traditional teams. This is where the problems may arise, changing one's mindset and attitudes from traditional way into Agile way [19][9]. We received similar response from one respondent who note that: "*We have difficulties in changing our peers' mindset*" – Developer

By exhibiting these so called "special traits", each member is expected to have a strong sense of belonging and responsibility towards a shared project goal. More importantly, they are actively involved in the development process. It is known that system requirements in Agile methodology are decomposed into smaller iterative segments and each iterative segment needs to be completed by team

members within the iteration period [16]. Consequently, team member must trust each other to have the same sense of responsibility in order to accomplish the goals of delivering the system. If any team member lacks in the sense of responsibility, the project can be considered to be at risk. We found from the respondents that IT practitioners in Indonesia were having problems such as sharing the same vision and mission towards the project: "*Not all people share the same sense of belonging and responsibility*" – Developer.

We also discovered that programmers in Indonesia tend to wait for work to be assigned rather than actively self-assign a new one: "*Most of the programmers still waiting for work given by upper management, there is no initiative to start other work once one task has completed*" – Developer.

In conjunction with that, we received responses indicating that there is a lack of trust towards Agile methodology from some of their peers since they completed their project using traditional methodology most of the time. Individuals tend to have trouble in adjusting to new environment or norms, in this case converting from traditional method into Agile method. They are afraid of leaving their "comfort zone", because adapting to a new environment requires time and effort. One respondent from our study state that: "*Build[ing] trust in new methodology is hard. Most of us dealt with traditional method for a long time, therefore we feel uncomfortable with the new practice.*" – Developer.

We received some responses stating there is a lack of competency in Agile methodology. Even though some of them may want to learn more about Agile, it appears that most of them were having difficulties to allocate adequate time to practice or to learn more about Agile. One reason given was that they were occupied with multiple projects at one time, while they were still working on completing the previous project. One of the respondents mentioned below statement:

"*Lack of competency on Agile methodology. We need time to learn it while the management keep give us new tasks simultaneously*" – *Developer*

4.2.2 External Factors

Engagement from customers or stakeholders in traditional methodology is typically limited to providing the requirements in the beginning of the project and also to provide feedback towards the end of project, usually with limited interactions between them. On the contrary, customer collaboration and cooperation is vital and often serves as a deciding factor in Agile methodology. Agile methods expect its customer to be actively involved in the development process involving them in writing requirements as user stories, product features, prioritizing features, and many other activities.

In Agile methods, customers are supposed to put the same interest on the project; hence cooperation from both development team and customers could run smoothly. However, we received concerned responses from our respondent on

cooperation and collaboration from the customers. They considered lack of cooperation and collaboration from customers as one of the reasons to why Agile methods were struggling to emerge in Indonesia. This is reflected in the following statement by one of the respondents:

> *"There is a lack of cooperation and collaboration from the customer. Some of them even do not care about it. All they care is the end product" - Developer*

Moreover, the practitioners also found that customers typically did not possess necessary knowledge on Agile methodology. Therefore, it had been a rather challenging task to convince customers to implement Agile methods in their project:

> *"Customers do not have knowledge on Agile methodology, so it's challenging to convince them to start using Agile in the development process" – Analyst*

Another remark given by one of the respondents is that having too many human resources can possibly hinder them from adopting Agile process. Given the large population of Indonesia, most companies could afford to provide a typically large development team. One of the respondents mentioned that:

> *"We have extensive resources, that is why it [is] difficult to convert into Agile because Agile team usually consists fewer individuals" – Manager*

Nevertheless, this point perhaps could be seen as a misconception about Agile software development approaches [7]. As highlighted by Ambler [7], team size is one of the "scaling factor" that can be addressed through team structuring.

5   Discussion

In this study, we have explored the perceptions of software practitioners towards the adoption of Agile methodology in Indonesia. A majority of the respondents in this study had heard of Agile and more importantly more than half of them had actually implemented Agile practices. However, only a small number of new software practitioners were aware of Agile software development methods. It might be possible that the lack of exposure to Agile methods in academic institutions in Indonesia being the reason why it was not known much among junior developers. This was the case for Thailand academic institutions where Agile topics were not included in University curriculum in general [24]. Hence, introducing Agile in some parts of the undergraduate curriculum could help improve the likelihood of being an early Agile adopter.

Even though we found some evidence of Agile adopters in Indonesia, we believe the awareness of Agile methods is still in its infancy. Our findings exemplify the lack of variety of Agile methods used by our respondents (i.e. only Scrum and XP). In our investigation, we also found the awareness is lacking not only among practitioners but also among customers. This discovery is in line with the findings from Asnawi et al. [8] on the emergence of Agile adopters in Malaysia. They

claimed that Agile adopters in Malaysia are still at the early stage and encountered the similar lack of awareness.

Introducing a new method is not an easy task and often certain constraints arise. As we mentioned before, majority of these constrains can be categorized into people, organization, and third-party/customer-related. In conjunction, Livermore [21] declared that there are several factors that impact the implementation of Agile methodology; he claimed active involvement and support from management has significant impact on the implementation of Agile methods. Meanwhile, Asnawi et al. [8] mentioned that the mindset of the people must be ready in order to adapt to Agile practices and it will be difficult to practice Agile when people are not willing to learn new things. In order that Agile works properly, collaboration and cooperation among team members and customer must work well. Therefore, people dependency remains as the biggest challenges in this study as well as Asnawi's [8].

This study has some limitations that should be address in future research. The first relates to the sample size – only 32 respondents. A larger sample would give a better statistical analysis [17]. Another limitation relates to the duration of the study which is only four months. This is because the study was conducted as a capstone project that last only a semester. A longer period of study is likely to have resulted in more data being collected. In the present study, the questionnaire was designed to measure the awareness of Agile among practitioners; hence the analysis was limited based on the data we have gathered.

6   Conclusion

This study is an important first step towards investigating the adoption and emergence of Agile software development methods in Indonesia and at the same time adding to the body of knowledge of Agile adoption from the Southeast Asia region. Some new research questions arose such as: Why customers hesitate to cooperate actively with developer teams? What causes the customers to work cooperatively with developer team? Why is there little awareness of Agile methods among new software practitioners and whether this is related to a lack of focus on Agile methods in universities? These are open questions available for future investigation.

We conducted a survey of 32 software practitioners across Indonesia. We found evidence that Agile software development methodology is starting to emerge in this country. In terms of awareness, we found that 87% of our respondents have heard of Agile. We discovered that there are several factors that currently restrict Agile practices in Indonesia: i) Lack of knowledge and competency in Agile; ii) tendency of people to resist changing their mindset from traditional to Agile; iii) lack of trust and support from management; and iv) lack of customer involvement. These factors have emerged to significantly limit the implementation of Agile

methodology in Indonesia. Nevertheless, our data indicate positive results in terms of respondents' willingness to learn about Agile practices. Approximately 80.9% respondents reported that Agile practices significantly improved software productivity whereas 81% perceived that adoption of Agile methods has made quality of their application better or significantly better. This led us to believe that Agile methods are likely to become popular among software practitioners in near future and will potentially become common practice for software industries in Indonesia.

This study has its own limitation due to its methodological bias. In particular, self-report studies are inherently biased because the results were drawn based on the users' perception which may be subjected to low validity. We believe that there are still many opportunities for the study on Agile methodology that awaits to be exploited. Future research should be conducted in a longer duration and to explore the issue of Agile adoption in Indonesia using both quantitative and qualitative approaches such as formal experiments, case studies, grounded theory or content analysis. Performing a qualitative study in future may be practical in order to better understand the issues and challenges faced by Agile adopters.

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