THE RELATIONSHIP BETWEEN

AGILE PRACTICES AND A TEAM'S MATURITY

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KEYWORDS: AGILE; TEAM MATURITY; TUCKMAN MODEL; AGILE PRACTICES; AGILE TEAMS

Abstract: The purpose of this study is to investigate the relationship between Agile practices and a team's maturity. This is a quantitative study that was carried out specifically to software developing organizations. The questionnaire was made up of questions to determine the Agile practices and characteristics of a mature Agile team. The questionnaire also included questions from the Tuckman model for team maturity. The results show that the way Agile practices are used can influence the team's performance and maturity level. Through the use of quantitative research, it was noted that there is a correlation between Agile practices and a team's maturity. This research study opens the minds of Information Technology (IT) professionals on how to build their teams in order to increase their skill levels to enhance project success. This research study has concluded that less mature teams need to be trained well enough with regard to Agile practices from an early stage to help them transition to a level of maturity that allows these teams to be self-managing and efficient within an organization.

1. INTRODUCTION

The Agile methodology was formed to ensure that projects can be completed faster through the use of Agile practices. However, when these practices are not followed or implemented well enough by the members of the team, it can result in failed projects. The Agile methodology was brought about with the aim of being able to adapt to rapidly changing software requirements changes in less time. The Agile methodology then comes with a list of practices that can be split into two categories; firstly, management or customer practices which look at the analysis of the requirements, planning of the project and the project management (VersionOne Inc., 2020). Secondly, are developer practices that look at how the code can be developed in an Agile manner using certain techniques (VersionOne Inc., 2020; Jorgensen, 2019). Agile practices are therefore concrete activities and practical techniques that are used to help develop and manage software projects in a way that is consistent with Agile principles (Sidky, Arthur, Bohner, 2007). The choice of Agile practices can then help a team in terms of what to do in order to be considered Agile. However, Agile practices are not always followed and this can lead to project failure (Jorgensen, 2019). There is still room for growth since not all organizations have adopted Agile practices, the recent study by VersionOne Inc. (2020) indicated that only 82% of organizations within that study are already implementing Agile practices. Failure to use Agile practices can then lead to problems such as going over budget, problems in the quality of the software, lack of communication with the client, and lack of progress monitoring (Recker, Holten, Hummel & Rosenkranz, 2017). Klarare, Hansson, Fossum, Fürst and Lundh Hagelin (2019) discussed team maturity in software development projects with more focus on the impact on productivity. Key findings from Klarare et al. (2019) revealed that identifying characteristics of team maturity and building mature teams could help with improving productivity in software development projects.

Mature teams refer to teams that have gained experience from multiple Agile projects or teams with more than a year of experience with Agile methods (Hoda, 2011; Klarare et al. 2019). Part of the reason Agile teams fail dismally with regard to project delivery is due to the fact that the teams are not mature enough to be involved in an Agile process which calls for teams that are self-managing (Ramírez-Mora, Oktaba & Patlán Pérez, 2020). In order to reach maturity in Agile teams, development of individuals is necessary to enable efficiency (Ramírez-Mora et al., 2020). The Tuckman's model of team development consists of four stages which are forming, storming, norming and performing (Tuckman & Jensen, 2010; Jones, 2019). Tuckman and Jensen (2010) concur with Ramírez-Mora et al. (2020) and state that this team development can be divided into four stages of maturity. The revised model as cited by Jones (2019) add the fifth stage, which is adjourning. This stage describes the termination of the team making the initial 4 stages more relevant (Jovanović, Mesquida, Radaković & Mas, 2016). For the purpose of this study, the focus will be on the four main stages and not the termination stage. Team maturity has an influence in the success of software development projects (Ramírez-Mora et al., 2020; Recker et al., 2017). The success of projects can also be determined by the maturity of the teams since they are expected to implement these Agile practices in their projects (VersionOne Inc., 2020). Hence, it is important to determine if there is a relationship between the Agile practices and a team's maturity as this will assist in understanding how teams of different maturity adopt these practices in software projects. This would then help to identify the right teams to work on projects based on their maturity, leading to more successful projects and greater customer satisfaction. Unless a team is properly set up it can fail and sometimes the fail is dismal and team maturity can positively influence how the team functions in software projects (Ramírez-Mora et al., 2020). This article is structured as follows: section 2 gives an in-depth literature review, section 3 is the problem statement with all research questions, section 4 is the research design and methodology and section 5 presents the research results and analysis.

2. LITERATURE REVIEW

2.1 Characteristics of mature teams in an Agile environment

Agile development has a great focus on collaboration, informal communication and organic organization form (i.e., having the ability to be flexible and adapt very well to changes) (VersionOne Inc., 2020; Nerur, Mahapatra & Mangalaraj, 2005). Mature Agile teams need to be well organized and be able to arrange daily meetings in order to monitor the progress of team members and also to know which individual is responsible for which tasks (Ringstad, Dingsøyr & Moe, 2011). Furthermore, a mature Agile team should be self-managed and empowered which then means that the team members are responsible for monitoring, managing and improvement of their own processes (Ringstad, Dingsøyr & Moe, 2011). In order for teams to be self-managing they require the capacity for learning as this will allow members to gain the multiple skills needed in order to perform each other's jobs as circumstances demand (Schulz, 2017). Therefore, in order to be successful with the Agile environment the team and the organization need to put great focus on the improvement of development practices as this will strengthen the team leading to a certain level of maturity (Nerur et al., 2005; Jones, 2019).

Sharp and Robinson (2008) re-iterate the point that Agile teams are self-organizing in nature and highly collaborative. In terms of the culture, mature Agile teams possess five characteristics: (1) respect on team and individual level, (2) responsibility on team and individual level, (3) maintaining quality of work-life, (4) confidence in own abilities and (5) trust (Sharp & Robinson, 2008). However, according to Hoda (2011), mature team members with previous experience with non-Agile software development methods tend to go back to their old ways leading to not following Agile practices. In a mature Agile team, senior members are hence expected to provide mentoring to newcomers, this mentoring role emerges on a need basis, and this shows the spontaneous nature of Agile teams in regard to self-organizing (Hoda, 2011; Jones, 2019). Another characteristic of mature Agile teams is the ability to be bilingual (i.e., communicating using technical language in development and also being able to translate to business language when working with customers) this skill can be attained through the use of existing Agile practices (Hoda, 2011; Jovanović, Mesquida, Radaković & Mas, 2016).

2.2 Impact of Agile practices on a project.

According to Schmitt, Theobald and Diebold (2019), there are three types of Agile practices namely management, development and standards and these affect the customer responsiveness of software teams differently. Agile practices help to improve the effectiveness or efficiency of a software team's response within a project (Schmitt et al., 2019; Ramírez-Mora et al., 2020). According to Diebold and Dahlem (2014) the list of Agile practices can be summarized as follows:

- Quality check: a process of verifying to ensure quality in the final software development projects.
- Refactoring: the reorganization of existing code to improve the design of the software.
- Customer involvement: this is to ensure that the customer gives feedback in the process of developing software development projects.
- Unattached communicative teams: these teams work together and have one vision in mind to deliver a working software.
- Validation practice: practices followed to ensure that the final software product is acceptable to the customers.
- Learning loop: describes the process followed to inform the project team on the activities to be implemented next.
- Outcome review: process of going over the final software product to check how it works for the purpose of improving in future projects.

- Planning meeting: focuses on plans to get all project team members to be committed.
- Timeboxing: a technique used to manage time to ensure productivity.
- Common knowledge: knowledge documented based on past projects and this is known by all project team members.
- Progress monitoring: allows project leaders to keep track of all activities within a project.
- Product vision: assists the project team to have a picture of the final software project and the problem the project is solving within an organization.
- Evolving and hierarchical specification: this helps with the reporting structure and it also assists in ensuring each project team member's responsibility.
- Continuous integration/deployment: refers to the principles enabling the project team members to implement changes automatically in early stages of software development life cycle.
- Delivering frequent releases: as the principle behind the Agile Manifesto, delivering a working software frequently is a practice within Agile teams.
- Small cross-functional teams: helps with knowledge sharing while collaborating in different projects while performing different project tasks.
- Daily discussion: helps in finding the status of tasks that were assigned to project team members and to solve problems if there are any in early stages of project development lifecycle.
- Continuous specification analysis: this ensures that as the project progresses, specifications are reviewed and analyzed to ensure that they are solving the problem at hand.

Agile practices have proven to be beneficial in terms of helping Information Technology (IT) software teams to produce quality software, which is on schedule and satisfies the needs of stakeholders. These practices assist software development teams to respond in an efficient manner to changes to the product that is being developed (VersionOne Inc., 2020; Jorgensen, 2019). In a general sense, Agile practices have a positive effect on project success (Serrador & Pinto, 2015).

However, when introducing Agile practices into a project, teams often experience difficulty with the adoption of these practices (Lautert, Neto & Kozievitch, 2019). This can bring about some setbacks as teams may not be able to see the benefits of Agile and this causes the team to neglect some practices leading to project failures. Agile management practices, e.g., daily stand-up meetings help to specify certain rules and procedures which then provide guidance on what process to follow, this then helps to groom the team and also progress can be monitored consistently (VersionOne Inc., 2020; Schwaber & Beedle, 2002). Agile practices have a positive impact on a project success rate as can be seen in Table 1, which shows a higher project success rate in Agile projects. The Agile method with the use of Agile practices had a 42% success rate, compared to just 26% for the waterfall model. **Table 1** shows that software development projects adopting Agile methods are more successful compared to software development projects adopting Waterfall methods.

	Agile	Waterfall
Successful	42%	26%
Challenged	50%	53%
Failed	8%	21%

Table 1: Comparing IT project success rate (source: Johnson, 2018)

*Challenged projects are defined as projects that were completed but went over budget or time. Failed projects would be projects that were not delivered or terminated before time while successful projects refer to projects that were delivered satisfactorily (Blaskovics, 2016).

2.3 Determining Agile team's maturity

Agile maturity assessment is a way of evaluating how a team is improving in terms of its ability to be Agile over time (Schmitt et al., 2019). Hoda (2011) further mentions that, mature teams refer to teams that have gained experience from multiple Agile projects or teams with more than a year of experience with Agile methods. Therefore, by assessing which behaviors are exhibited by a team in their daily practice, the strength and maturity of the underlying practices can be assessed (Schmitt et al., 2019; Ramírez-Mora et al., 2020). The Agile Maturity Model (AMM) can be used to show how Agile software practices mature from an initial level based on the Agile principles and practices (Patel & Ramachandran, 2009). AMM assesses the team maturity to be Agile and this is necessary to evaluate even the organizations' agility (Patel & Ramachandran, 2009). The AMM can be applied in different ways to measure teams' maturity, however, Klarare et al. (2019) argue that it can be applied through the use of a questionnaire to understand the development, effectiveness and productivity of the team.

When making use of models Rodrigues and Fontana (2018) state that it is necessary to measure where the teams stand according to the model. Team maturity should then not be overlooked as studies have shown that focusing on team development can greatly increase the team's performance, which can lead to project success (Serrador & Pinto, 2015; Jorgensen, 2019). Serrador and Pinto (2015) further mention that measuring how strictly the Agile principles and practices are used isn't the point of team maturity, however being a firm believer in the Agile mindset to become successful, then assessing the team against the Agile principles can be useful. As mentioned by (Tuckman & Jensen, 2010) there are 4 stages that a team can reach in terms of maturity: (1) forming, (2) storming, (3) norming and (4) performing. These are known as Tuckman's stages of team development. **Table 2** illustrates the stages of team development.

Mature team members should be able to handle routine and unexpected situations (Klarare et al., 2019). In order to determine the team's maturity, the Tuckman Model for team development was developed. According to Tuckman and Jensen (2010), this model explains that when teams start developing maturity and abilities, relationships are formed within the team members and also the project leader changes the choice of leadership style.

Stage	Description and relation to Agile PM
Forming	This first stage is when the team is built up and the individuals in the team are still new and getting used to the new environment. Also, relationships are built at this stage. Teamwork is non-existent at this point as individuals are mainly working independently.
Storming	This is the second stage; at this point the members of the team have adjusted to the new environment. People try to position themselves within the team, however this can cause conflicts with regard to be handling some situations. It is therefore up to the team leader to ensure proper handling of the team at this stage.
Norming	This is the third stage; team members should be clear their responsibilities, methods of working and how to interact with one another. The culture of the team will be normally established and adopted by every member allowing the team to focus on delivering set objectives.
Performing	At this fourth stage, the team will have reached an ultimate stage of maturity whereby there is minimal supervision from the project leader.

Table 2: Stages of team development (Tuckman & Jensen, 2010; Ramírez-Mora et al., 2020; Jones, 2019)

3. PROBLEM STATEMENT

With the growing demand for producing quality software that meets customer's expectations within a short space of time, Agile principles and practices are not being implemented correctly and this has severe effects on the success rate of IT projects. An Agile team has many similarities to a mature team (Gren, Torkar & Feldt, 2017; Jorgensen, 2019). Agile principles and processes provide a guideline on how to implement Agile correctly (Ramírez-Mora et al., 2020). Therefore, there is a need for research to determine whether there is a correlation between Agile practices and a team's maturity. Once this has been identified, guidelines need to be developed in order to ensure that Agile practices are adopted properly in less mature teams as this will assist organizations with identifying teams for the right projects in order to deliver on projects effectively. The main research question addressed by this study is: what is the correlation between Agile practices and a team's maturity?

4. RESEARCH METHODOLOGY AND DESIGN

In this research, a quantitative methodology was used. Quantitative methods focus on objective measurements and statistical or numerical analysis of the data which was collected through online questionnaires (Creswell & Creswell, 2017; Saunders, Lewis, Thornhill, 2019; Creswell & Clark, 2017). Once numerical data is collected, this data can then be analyzed, generalized, and used to explain a certain phenomenon (Saunders et al., 2019; Creswell & Creswell, 2017). The researchers sought to investigate the correlation between Agile practices and a team's maturity and therefore the focus was on teams (i.e., people) within an organization and the practices they use in an Agile context. For measuring the relationship between certain variables, a descriptive research design was deemed suitable. A descriptive study establishes only relationships between variables (Saunders et al., 2019; Creswell & Creswell, 2017). Positivism philosophy is for scientific research with more focus on large samples that can be used to generalize based on key findings (Creswell & Clark, 2017; Saunders et al., 2019). Quantitative studies are characterized by positivism philosophy (Saunders et al., 2019), hence the study followed a positivism philosophy.

This data collection tool covered questions on the Agile practices used by Agile teams, the characteristics of an Agile team and questions from Tuckman's model to help to determine the maturity of a team. This questionnaire took about 10 minutes to complete and there were no optional questions. The online questionnaire was sent out electronically to 50 employees who are working on Agile practices on a daily basis at organization X based in the Gauteng province in South Africa, however only 32 participants responded resulting in a 64% response rate. These employees were working in different Agile projects and belonging to different teams.

After the data was collected, cleaned and coded it was analyzed by making use of IBM SPSS Software. This software then made it possible to perform statistical analysis of the different variables that were made up of the questions from the data collection tool. The questionnaire did not allow any incomplete information to be stored and this is the reason no invalid responses were collected. This research made use of purposeful or selective sampling. Purposeful sampling is a sampling technique that quantitative researchers use to recruit participants who can provide in-depth and detailed information regarding the phenomenon under investigation (Saunders et al., 2019; Anwar, 2017). The unit of analysis was people using Agile in organizations e.g., project managers, developers, Scrum masters and testers within different teams.

Past literature informed the questions in the questionnaire. According to Field (2017) construct validity measures what it purports to measure. Construct validity was used in this study. Table 3 shows the reliability statistics. A total number of 27 items were tested resulting in a Cronbach's Alpha of 0.879 meaning that the items tested were reliable.

Items tested	Cronbach's Alpha
Characteristics of mature teams (9 items)	.862
Agile practices (18 items)	.851
Total (27 items)	.879

Table 3: Reliability statistics

5. RESEARCH RESULTS AND ANALYSIS

5.1 Demographics

The results indicate that 59% of the respondents were from the IT industry. These results cannot be a surprise since Agile was introduced for software development projects. These results can also be supported by VersionOne Inc. (2020), where IT industry was leading. Scrum masters amounted to 25% and the majority were developers with 62.5%. With regard to years of experience, the majority of respondents with 87.5% have 0-4 experience, followed by 6.3% with 5-9 years of experience and 6.3% with 10-19 years experience.

5.2 Maturity level

Figure 1 illustrates that the majority (71.9%) of the respondents are in teams that are at a high level of maturity, i.e., performing. Also, it can be noted that none of the respondents were in the forming state of team development.

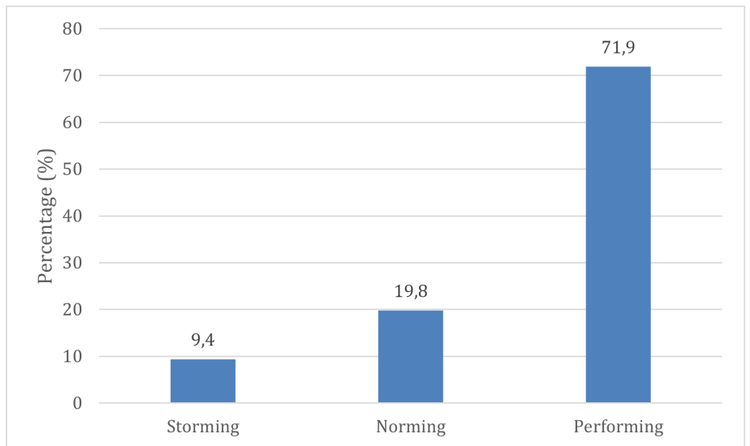

Figure 1: Maturity level

Table 4 illustrates the stages of the team's development and the characteristics of mature teams. Table 4 supports Figure 1 and the objective is to map the stages of team maturity and the characteristics of mature teams. It can be concluded based on the results that most teams that were investigated are in the performing stage of team development with most team members embracing self-management followed by managing their own processes. It could be an indication of some expectations required from these teams at the performing stage. At the same time, it can be noted none of the project team members are in the forming stage meaning that Agile projects members are embraced by well-developed teams.

5.3 Characteristics of mature teams

From the results illustrated in Figure 2, it can be seen that certain similarities can be drawn from the literature. The maturity level of the team is at a performing level, which is a high level of maturity as

mentioned by Tuckman and Jensen (2010). From the results, it can be deduced that the majority of the respondents have experience of up to 4 years, this then conforms to what Schmitt et al. (2019) mention since these respondents have been exposed to multiple projects and they have more than a year experience with Agile practices. Furthermore, team maturity can greatly increase team performance and project success (Serrador & Pinto, 2015; Jorgensen, 2019). Software development projects' success is achieved by delivering frequent releases by mature teams who follow Agile practices on their projects.

Figure 2 shows that collaboration (71%) among mature teams standout leading to the success of IT projects. Without collaboration of team members with their own different skills, it will be difficult for the team to achieve its ultimate goal of delivering a project successfully. Collaboration is followed by trust (62%), this can make more sense as it will be easy to collaborate with team members that can be trusted. Learning new skills follows at 61% and confidence in own abilities ties with self-managing both at 54%. Ringstad, Dingsøyr and Moe (2011) stressed the point that mature Agile teams should be self-managed and empowered which then means that the team members are responsible for monitoring, managing and improvement of their own processes. The results obtained confirm to their statement above as the majority of the respondents agree that their teams are self-managing (54%), responsible for monitoring, managing and improving their own processes (43%). This also conforms to the statement given by Sharpand Robinson (2008), who mention that Agile teams are self-organizing. From the results it can be deduced that the majority of the respondents agree that these characteristics exist within their Agile teams, thus making these teams mature.

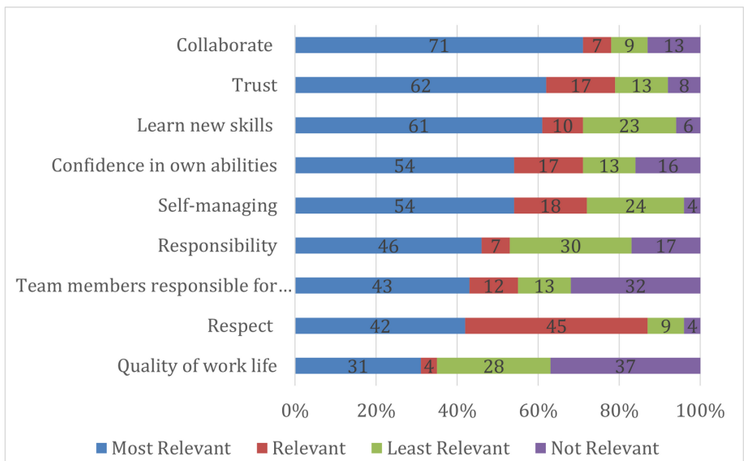

Figure 2: Characteristics of mature teams

5.1 Agile Practices

In terms of the Agile practices practiced, the following practices, as illustrated in **Figure 3** stood out from the results: customer involvement (67%), daily discussions (63%), progress monitoring (61%), delivering frequent releases (58%) and common knowledge (44%) as top five practices among Agile teams. It is clear that most of the respondents use these practices, as shown in **Figure 3** while working on their Agile projects. As mentioned by Serrador and Pinto (2015), Agile practices have a positive effect on project success. These results are supported by VersionOne Inc. (2020) where they mentioned that customer involvement is a key technique employed in Agile and daily discussions is the top practice in Agile.

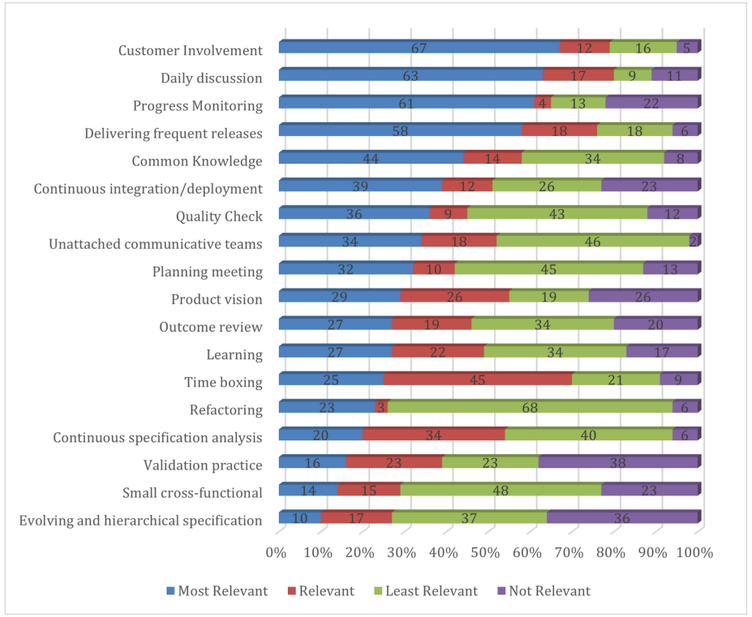

Figure 3: Most relevant Agile practices

5.5 Correlation between Agile practices and Maturity levels

A Pearson correlation analysis test was performed to determine whether there are any significant correlations between Agile practices and the characteristics of mature teams. Correlation coefficient values range from -1 to +1 and these values indicate the strength of relationships between values (Field, 2017; Pallant, 2016). Pallant (2016) sets guidelines to interpret these values, that is r =0.1 00 to 0.290 indicates small relationship, r = 0.300 to 0.490 indicates medium relationship and r = 0.500 to 1.00 indicates a strong significant relationship. Appendix 1 illustrates the full correlations results and no strong negative correlations were noted. The objective was only to highlight some of the key correlations. The following strong positive significant correlation was observed:

- · The results indicate that there is a strong positive significant correlation between the customer involvement and responsibility in own abilities (r =0.586** and p-value = .000).
- · The results indicate that there is a strong positive significant correlation between unattached teams and quality of work (r =0.698** and p-value = .000).
- · The results indicate that there is a strong positive significant correlation between validation practice and quality of work (r =0.629** and p-value = .000).
- · The results indicate that there is a strong positive significant correlation between validation of work and respect (r =0.545** and p-value = .001
- · The results indicate that there is a strong positive significant correlation between outcome overview and confidence in own abilities (r =0.625** and p-value = .000).

The results indicate that mature teams make use of Agile practices extensively. This shows that there is a link between Agile practices and team's maturity. This answers the research question that was aimed to find out if there is a correlation between Agile practices and a team's maturity. To further confirm this relationship, the correlation analysis as depicted in **Appendix 1**, also shows that there is a relationship between Agile practices and a team's maturity across

all levels. These Agile practices that correlate with team maturity have great influence with regard to determining the maturity level of teams. Agile practices help to improve the effectiveness or efficiency of a software team's response within a project (Schmitt et al., 2019; Jorgensen, 2019). This then means that if Agile practices are used properly it can then have a positive impact on project completion time. One would have expected that the Agile practices that have correlated with team maturity would have been on the top most used/relevant Agile practices in **Figure 3** however, in this case it is not true. This should raise a question to the Agile teams to practice more on these practices that have correlated with team maturity as they ultimately determine team maturity and project success as well.

6. DISCUSSIONS AND CONCLUSIONS

The main aim of this paper was to see how Agile practices are related to a team's maturity (characteristics of mature teams). With quantitative data from the questionnaire, results have established some correlations between the two measured variables. Building mature teams is a process and organizations should spend time building their teams to reach a mature stage. Since the results have revealed that Agile practices have significant correlations with team's maturity, it is, therefore, a call to practitioners not to treat Agile practices and team maturity in isolation. In order for the team to easily practice the Agile practices that can lead to project success, building them should be the first priority.

The results reveal that an Agile team's maturity level and the Agile practices used within that team are correlated. This could then help to understand the importance of ensuring that teams are developed well from the forming stage up until the performing stage where the team can be self-managed. These results could then help to understand the importance of Agile practices as well. Organizations that make use of Agile practices in their environment would then be able to understand how they should build their Agile teams. The fact of the matter is that teams will not find themselves in a high maturity level if the necessary learning environment is not put in place. Therefore, it is important that the necessary skills are developed from the early stages of team development. Problems such as going over budget, problems in the quality of the software, lack of communication with the client and lack of progress monitoring could then be avoided. This then helps to ensure that projects are delivered on time, bringing satisfaction to the customers and the organization.

No weak relationships were observed, only moderate and strong relationships, this is also a confirmation that there a significant relationship between Agile practices and the characteristics of team maturity. Another interesting fact to note is that all Agile practices are either moderate or strongly significant with at least one characteristic of mature teams. **Figure 4** summarizes key correlations.

7. FUTURE RESEARCH STUDY AND LIMITATIONS

Since the results were somehow misaligned between some Agile practices commonly used among Agile teams and the Agile practices that correlate with team maturity, therefore, future research studies could focus on teams' alignment towards team maturity to improve project success. Since not all the most relevant Agile practices that correlate with team maturity are the most adopted with Agile teams, therefore, it is a call for Agile teams to grow. Teams that want to grow must always be willing to accommodate unplanned and critical tasks, embracing daily discussions about the projects, allowing software requirements to change and be willing to undergo continuous learning. Future research studies could focus on the determinants of team growth and how teams could reach their maturity stage. Another interesting future research planned from this research is to focus on correlations between the implementation of Agile practices by

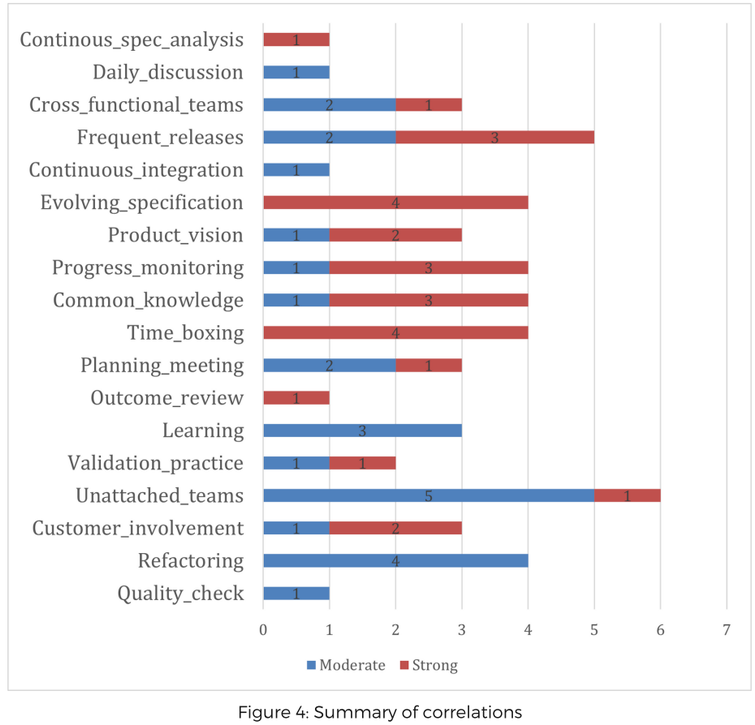

Figure 4: Summary of correlations

mature teams and scaled Agile project success. A key limitation is that this study reveals the researchers' perception of maturity and does not imply the real maturity as they could provide positive bias answers. Another limitation is that the data has been collected from a single organization, so more context and research exposure are required to elaborate on the findings.

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THE RELATIONSHIP BETWEEN

AGILE PRACTICES AND A TEAM'S MATURITY