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Factors that Influence the Decision-Making Process in Agile Project Teams Using Scrum Practices

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Abstract

This paper examines whether the linear decision-making process is used in the context of agile project teams using scrum practices and to identify factors that negatively influence the linear decision-making process during the sprint planning and daily scrum meetings. We conducted 34 interviews and 18 observations across four agile project teams. Our findings show that a linear decision-making process is not always followed in these two meetings and that a number of factors can negatively influence the linear decision-making process. As these teams work to short, tight deadlines and need to make informed decisions quickly in order to meet short-term goals, these factors can negatively impact on the team and result in sprint failure or reduced effort by team members. This research contributes to the decision-making literature and project management literature by highlighting difficulties applicable to decision-making in an agile environment.

Keywords

Decision-making, agile teams, sprint planning, daily scrum

INTRODUCTION

Scrum (Schwaber and Beedle, 2002) is an agile project management (APM) methodology commonly used in industry as a study of 2,750 organizations found 74% of respondents using either Scrum, eXtreme Programming or a hybrid of both as their chosen agile methodology (VersionOne, 2009). APM methodologies such as Scrum develop software in short time periods (sprints), emphasizing the agile team and the role of the individuals within the team. Teams are small, often fewer than ten members (Cockburn, 2001), collaborative, and empowered to make decisions (AgileAlliance, 2001). The structure of an APM team is flexible and adaptable with team members interchanging roles to gain new experiences (Nerur, Mahapatra and Mangalara, 2005). This includes the role of the project manager who is not the accountable decision-maker but more a facilitator or coordinator (Alleman, 2002; Lindstrom and Jeffries, 2004) and the role of the customer who is continuously involved in the development process (Beck and Andres, 2004). As APM teams self-organize all team members contribute, with decisions made collaboratively (Nerur et al., 2005; Schwaber and Beedle, 2002), such as decisions for changing requirements; identified problems requiring resolution; and new ideas generated which must be explored (Austin and Devin, 2009).

Prior research of how software development teams (SDT) make decisions developed a linear decision-making model (Mintzberg, Raisinghani and Théorêt, 1976). This model identified factors affecting decisions for requirements engineering (Alenljung and Persson, 2008) and found that groups, rather than individuals, make software decisions. However, software development moved away from a linear development process akin to a relay race where the

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product is passed from one group to the next to a more interactive group process with a multidisciplinary team working together from start to finish akin to a rugby team (Takeuchi and Nonaka, 1986), i.e. APM. The linear decision-making model (Mintzberg et al., 1976) seems appropriate for traditional SDT teams with more rigid team structures and roles but less so for APM teams. Unlike traditional SDT teams, APM teams' decision-making can be impacted by the team's empowerment and cohesiveness (McAvoy and Butler, 2009) as such teams are empowered with autonomy to make decisions about their tasks and processes (AgileAlliance, 2001). APM team members may be involved in decisions outside of their traditional skill areas due to their self-organizing, flexible team structure, although theoretically the customer drives the APM team who is seemingly responsible for all technical decisions with the customer responsible for requirements implementation decisions (Abrahamsson, Salo, Ronkainen and Warsta, 2002). APM teams may make quick decisions to maintain task momentum, even though these decisions may be reversed at a later date once further information is available (Schwaber and Beedle, 2002). Therefore, with APM taking a more flexible approach to development, this paper explores whether APM teams use the linear decision model that traditional linear development teams used or whether a more flexible decision process is used in keeping with the notion of being agile.

This paper also focuses on identifying the factors negatively affecting linear decision-making during two frequent key team meetings: the Sprint Planning Meeting (SPM) and Daily Scrum Meeting (DSM) (see Table 1) to demonstrate where the linear decision process may be hindered. Decisions are also made outside of these meetings, but these two meetings provide a regular touch-point for all stakeholders, both business (customer) and technical (developers, quality assurance), where all are expected to actively participate and contribute to decisions made. Because agile methodologies and practices are rarely implemented based on textbook definition and are tailored to suit the needs of individual teams, sometimes not even consistently within teams in the same organization (Fitzgerald, Hartnett and Conboy, 2006; Law and Charron, 2005), we selected these two practices because they were two commonly implemented practices that we could observe. Additionally, there is limited research on specific aspects of some agile practices with recent calls for further empirical research on agile methodologies (Dybå and Dingsøyr, 2008), specifically research that is more practice-focused (Maruping, Venkatesh and Agarwal, 2009). Hence, we chose to explore the decision process on these two practices.

Meeting	Description
Sprint Planning Meeting	Meeting taking place at the start of each sprint where the team collectively define and plan tasks to be completed during the next sprint (Schwaber and Beedle, 2002).
Daily Scrum Meeting	Short daily status meeting lasting a maximum of 10-15 minutes typically conducted at the same time each day with team members standing up. Team members explain briefly what they accomplished since the previous meeting, what will be completed by the next meeting and any impediments that may prevent them from completing their current tasks (Schwaber and Beedle, 2002).

Table 1. Meetings Where Agile Project Management Teams Make Decisions

The remainder of the paper is structured as follows. The next section presents this study's decision-making process (Mintzberg et al., 1976; Saarelainen, Koskinen, Ahonen, Kankaanpää, Sivula, Lintinen, Juutilainen and Tilus, 2007), followed by the research approach and our empirical cases. Finally, results are presented and discussed.

DECISION-MAKING PROCESS

This paper defines a decision as the point in time when a team or an individual commits themselves to a course of action where multiple reasonable alternatives exist even if they are not identified or compared (Klein, 2008) and a decision process as the set of actions beginning with the identification of a stimulus for action and ending with the specific commitment to action (Mintzberg et al., 1976). The decision-making model defined by Mintzberg et al. (1976) has been

adapted (Saarelainen et al., 2007) as this paper's model (see Figure 1). It contains three phases: the

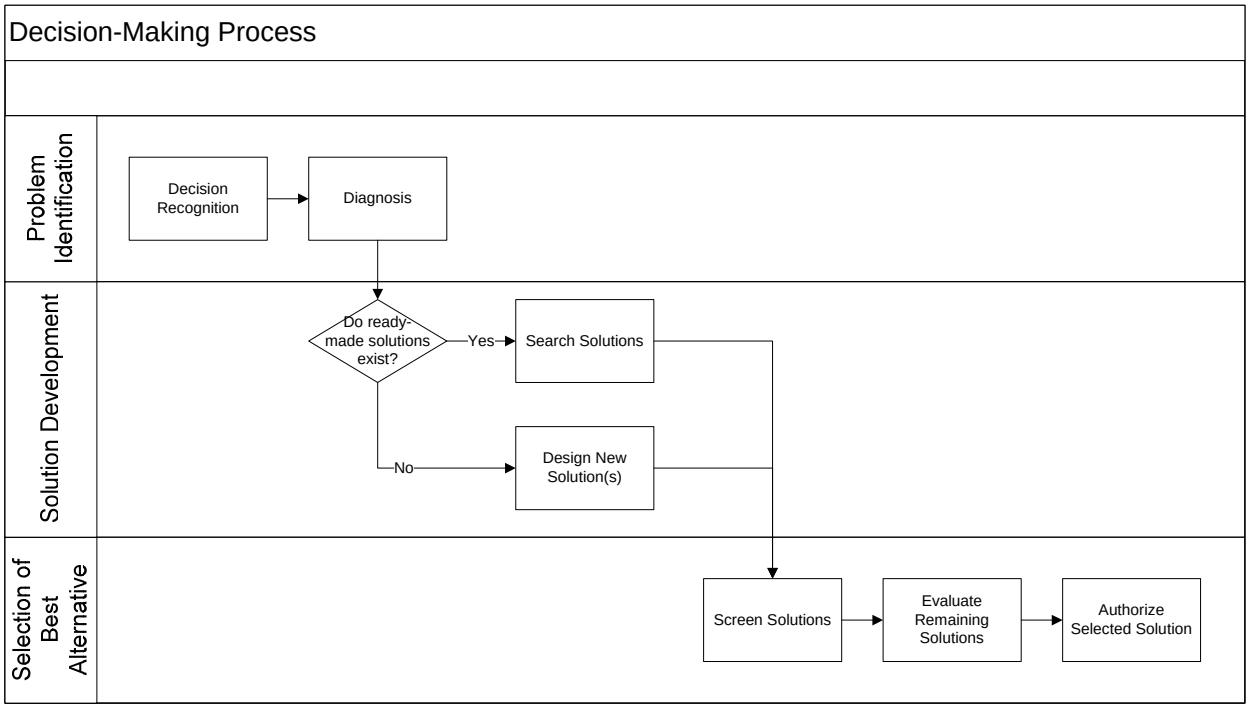

Figure 1. Decision-Making Process (Adapted from Mintzberg et al. (1976) and Saarelainen et al. (2007))

Problem Identification, Solution Development, and Selection of the Best Alternative. The identification phase identifies the problem via two routines: decision recognition, which identifies opportunities and problems evoking decision activity, and diagnosis, where decision-makers try to make sense of the opportunities and problems to understand the decision situation and its cause-effect relationships (Mintzberg et al., 1976; Saarelainen et al., 2007).

The second phase identifies solutions to the problem via two routines: the search routine searches ready-made solutions and the design routine creates new solutions to the problem. This phase is the core of the decision-making process and requires the greatest amount of resources (Mintzberg et al., 1976; Saarelainen et al., 2007).

The third phase selects the best solution. It includes three routines: the screening routine removes infeasible solutions quickly without intense evaluation, the evaluation routine evaluates the remaining solutions to determine which is appropriate, and the authorization routine authorizes the accountable decision-maker to implement the solution. The overall decision process may include many selection phases because the development phase often involves breaking one decision into multiple sub-decisions each requiring their own selection phase (Mintzberg et al., 1976; Saarelainen et al., 2007).

This linear decision-making process is used by SDTs, but may not be appropriate for the more flexible, self-organizing APM teams. APM teams also do not exhibit all agile practices and so this study examines whether APM teams even use the traditional linear decision process with the following research objectives:

- Explore whether a linear decision-making process is used in the sprint planning and daily scrum meetings
- Identify factors that negatively influence the three phases of the linear decision-making process during the sprint planning and daily scrum meetings

RESEARCH APPROACH

We conducted a multiple-case study approach as case studies are a suitable approach for exploratory research (Yin, 2009) with multiple case studies considered more robust than single case studies (Benbasat, Goldstein and Mead, 1987). The unit of analysis was the APM team. We purposely selected teams on the basis of their diversity of distributedness and industry setting. Each of the four teams studied used an agile methodology for a minimum of six months and regularly held SPMs and DSMs. These cases provided the researchers with an opportunity to explore each particular situation in detail, but they are solely representative of the experiences of these four teams.

Data Collection and Analysis

Data collection consisted primarily of 34 structured interviews across four teams (see Table 2) with individual team members using an interview protocol (see Appendix for interview protocol excerpt). The questions were open-ended, which allowed respondents to freely express their views as recommended by Yin (2009). Interviews varied between 50 and 75 minutes in length with each interview audio-recorded and transcribed. Observations of 18 SPMs and DSMs supported the interviews, allowing us to see and hear how the teams made decisions. We documented these observations as field notes and sought clarification from team members after the meetings when required.

The analysis strategy was designed to establish the decision-making process in the two meetings studied and identify and code the factors negatively influencing decision-making in such meetings. To address the research objectives, the transcripts and field notes were read to obtain insight into each case. The decision-making process and factors that negatively influenced decision-making in the two meetings were identified from a number of sources: some were explicitly stated by team members whereas others emerged from the interview data and observations. Each factor was coded to help organize the data and identify patterns and themes in the two meetings across the four cases. It also allowed for data validation from different individuals and observations (Miles and Huberman, 1999).

Cases Studied

The size of the four teams was similar, with two of the teams co-located and two teams distributed. Two of the teams (C2, C3) had dedicated customer representatives, called the Product Owner, who actively participated in both meetings. In C1, the customers, based in the United States, rarely participated in any meetings with the core development team who were based in Ireland. In C4, the customer representative (business analyst or BA) only participated in the SPM (see Table 2 for team summaries).

	Case C1	Case C2	Case C3	Case C4
Organization Location	Ireland USA India	Sweden	Ireland	Ireland India
Industry Sector	Financial Services & Investments	Engineering	Software Development	Software Development
Multi-National Organization	Yes	Yes	Yes	No
Team Distribution	Distributed	Co-located	Co-located	Distributed
Team Culture	Multi-cultural	Single culture	Multi-cultural	Multi-cultural
Team Size	8	9	8	9
Team Composition	1 Project Manager 1 Business Analyst 1 Technical Architect 5 Developers 2 Quality Assurance	1 Scrum Master 1 Product Owner 7 Developers	1 Scrum Master 1 Product Owner 5 Developers 1 Quality Assurance	1 Scrum Master 1 Business Analyst 4 Developers 3 Quality Assurance
Average years software development experience	11 years	14 years	10 years[5]	8 years
Average years employed by the organization	4 years	15 years[6]	5 years	4 years
Length of time since agile implementation	2 years	9 months	11 months	1 year
Customer	Internal, based in the United States	Internal	External, but internal customer, representative	External
Number of Observations	2 Sprint Planning 2 Daily Scrum	1 Sprint Planning 3 Daily Scrum	1 Sprint Planning 2 Daily Scrum	3 Sprint Planning 4 Daily Scrum

Table 2. Profile of Participating Teams

C1 was a multi-national financial services organization with the development team primarily based in Ireland, the Quality Assurance (QA) function based in India, and a database specialist and customers based in the United States. This team had been using Scrum practices on their current project for over two years and had retained the traditional

[5] One individual had 30 years experience in the software industry. The remaining team members had between 3 years and 11 years experience in the software industry.

6 One individual has been employed by Case C2 for 30 years, but worked as an electronic engineer for the first 15 years. This is included in the calculation.

role of the Project Manager. The second team, C2, was co-located in Sweden in an organization that developed and manufactured high voltage protection and control products for an internal customer. This team had been using Scrum for nine months. The third team, C3, was a co-located team based in Ireland in an organization which developed and sold software products to the insurance industry. This team was the first within the organization to implement Scrum, which was in use for 11 months. The final team, C4, also based in Ireland, was in an organization that is the market leader for corporate actions and custody solutions to the investment services industry. The team studied was distributed between Ireland and India and had been using Scrum for 11 months. All team members were employees of their respective organizations.

FINDINGS

The first aim of this study was to investigate whether the SPMs and the DSMs followed the linear decision-making process as presented in Figure 1 and secondly to identify any factors that negatively impacted this decision-making process in such meetings. The findings show that the linear decision-making process is only used in certain circumstances and that the following factors can affect whether this decision-making process is utilized.

Decision-Making Process

The decision-making process was examined in each of the teams through observations and interview data collected. In C1 the linear decision-making process was not followed because several decisions were made outside the SPM e.g. tasks assigned by the project manager and solutions and estimates determined by the developers which the team reviewed and confirmed during the SPM. This may be because the team retained the roles traditionally used in software development. This team was also under sustained pressure to deliver functionality in a short period of time which likely resulted in "*people who know certain areas being thrown at that area again [C1, Developer 1]*" as they would complete it in the shortest timeframe.

C2, C3 and C4 also did not follow the linear decision-making process (Figure 1) in the SPM when problems identified were new and the teams did not know how to develop a task. As a result, they could neither make decisions about how to develop that new functionality nor about how many sub-tasks were needed and their estimates. To resolve this, workshops were scheduled to address these decisions to avoid a "*planning meeting that is much longer and less efficient [C4, Developer 1]*". C4 also "*added an extra task for a research spike to allow some time to think how to do it [C4, Developer 1]"*. In C2 spikes were not used and such tasks were assigned to non-team members for investigation. For identified problems familiar to team members, the linear decision-making process was followed during the SPM with decisions made collaboratively in a tight timeframe due to the nature of the meetings. Each item was discussed in turn with team members proposing and discussing various alternative solutions, with conflicts and trade-offs identified and estimates determined [Observation C2, C3, C4].

During the DSM the decision-making process was not always linear. These meetings were short in duration (approx. 15 minutes) and decisions were needed quickly to progress: *"I don't spend much time on decisions because you don't get much time [C4, QA 1]"*. Where all information or personnel were not available to make a decision, the evaluation of alternative solutions was not possible, so additional meetings were scheduled with relevant team members to discuss the problem and decide the most appropriate solution as *"sometimes you'd have a couple of different ways to do something and we'd spend a bit of time looking at options [C4, BA]"*. Due to the time pressure to deliver functionality frequently to the customer, C4 felt there was no point in making decisions in a *"quick fix way [C4, BA]"* because the team would eventually have to redo the quick fixes if they failed in the future. However, C1, where the customer was rarely present, adopted a different approach. Due to time pressure, this team often made decisions in order to progress as they did not have the luxury of time to wait for a customer decision as "*it might take a week to get a response [C1, Developer 2]*". But, the team recognized that the customer may "*want some things differently to what we have planned [C1, Developer 3]*" which may result in revised decisions at a later date.

Factors that Influence Decision-Making

Seven factors were identified that negatively impacted the linear decision-making process in the two meetings studied, making it difficult for teams to adhere to the linear decision-making process. Some decisions were team decisions whereas in other instances, individuals made decisions that affected the outcome of the project. Summarized in Figure 2, all factors identified influenced the decision-making process in the SPM (cross-hatched bars), whereas three factors impacted the DSM (the split cross-hatched and solid colored bars).

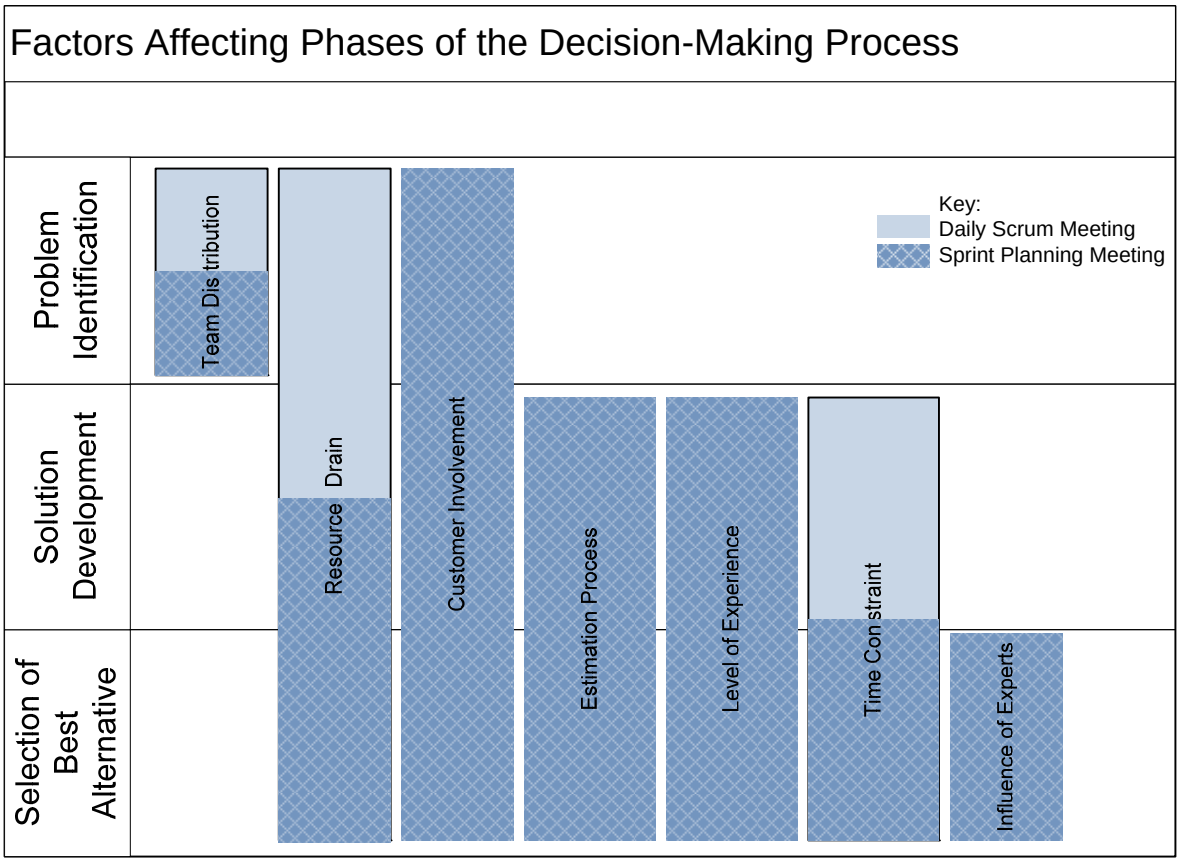

Figure 2. Decision-Making Factors Influence Different Decision Process Phases in the Sprint Planning Meeting and Daily Scrum Meeting

- *Team Distribution*

Teams in C1 and C4 were distributed, which caused difficulty with problem identification, the first phase of the linear model, in both meetings. Time zone differences and dependencies on distributed team members prevented timely decision-making and made it difficult for teams to make design decisions at both meetings as whiteboards and distributed team members were not visible to each other. In C1 and C4, QA team members based in India regularly participated in the SPM even though this required them to work additional hours when the SPM was conducted, but they did not participate in the DSM. Some team members in C1 felt that QA's participation and their contribution to decisions were limited; for example, "*they give their status and then just go back and speak to the domestic team [C1, Developer1]*", which may be partially due to both the distribution of the team and their culture.

- *Resource Drain*

In C2 and C4 difficulties arose when individuals had to complete tasks for other projects, thereby affecting all phases of the decision-making process in both meetings. While all team members participated in the meetings, their time during each sprint was often divided between projects. As a result, the team did not "*have enough full-time team members [C2, Product Owner]"*. This impacted on problem identification in the SPM with the availability of team members varying from one sprint to the next. C4 experienced a problem where the composition of the team was unknown at the start of the sprint or resources were temporarily transferred to other projects mid-sprint to resolve a customer issue. This caused difficulty when one developer was dependent on another to evaluate and develop solutions and that resource was temporarily unavailable. It "*throws your plan out the window so we have to re-evaluate [C4, Developer 1]*" at the DSM. Besides being disruptive to the team, specific information known to that individual was no longer available to the rest of the team. This also contributed to the failure of sprints in both teams.

- *Customer Involvement*

In Scrum it is recommended that the customer, or Product Owner, is part of the team and participates in SPMs to assist in all phases of the decision-making process. This occurred in C2, C3 and C4 where tasks were prioritized by the team in conjunction with the Product Owner [Observation C2, C3, C4] who was considered a valuable part of the team. The team was able to *"ask him [questions] and get instant feedback on decisions [C3, SM]"*. This contrasted with C1 where the Project Manager prioritized tasks as the customer rarely participated in the SPM. C1 regularly experienced difficulties in obtaining decisions from the customer. It is *"hard to get their time,…they are very slow to make decisions [C1, Developer2]"*. The customer in this case was distributed from the core development team and chose not to participate or delayed participation. As a result, the team made "*assumptions [C1, Developer1]*" in order to progress the project, which sometimes needed to be reversed. The team believed that the customer's lack of participation and untimely decision-making was highlighted as a result of using an agile methodology and caused them frustration and difficulty with setting and achieving goals for the sprint.

- *Estimation Process*

C2 and C3 collaboratively discussed and estimated tasks in the SPM, which affected the second and third phases of the decision-making process. This promoted cooperativeness and honesty amongst the team because the estimates were "*more accurate and more realistic [C3, Developer 2]*". This contrasted with C1 and C4 where tasks were estimated by the person considered most appropriate for the task. In C1 tasks were pre-assigned to team members by the Project Manager to "*whomever is responsible for certain areas [C1, Developer1]*". This resulted in little discussion or evaluation of alternatives at the SPM in relation to the estimates proposed for each task as "*each developer does their own [C1, Developer]*". Estimates were rarely questioned by other team members [Observation C1]. In C4, team members provided their own estimates, but senior developers often amended them based on their experience and knowledge of junior members' capabilities because the "*last thing we want to do is give a short estimate for something [C4, Developer 1]"*, which could create delays in delivering functionality.

- *Level of experience*

Team members used prior experience when making decisions in the SPM, which affected the second and third phases of the decision-making process. For example, if "*someone has done it [a task] before then we usually have good estimates...and they are quite realistic [C2, Developer 7]*". Conversely, inexperienced individuals had difficulty contributing to a discussion in relation to unknown or complex tasks because they lacked experience or knowledge to comment and were passive: "*Sometimes I may not know anything about the task, so I sit and listen [C2, Developer 3]*". New or inexperienced staff often underestimated the time required to complete tasks: "*You wouldn't have seen some challenge or some obstacle, so your initial estimate would have been delayed [C1, Developer 4]*", or based their estimates on those set by experienced developers even though they themselves may not be able to complete the task in the same amount of time. Yet, they agreed with the experienced developer as they did "*not want to be seen to be wrong [C3, Scrum Master]*".

It was also difficult for all teams to make decisions when they had insufficient information or knowledge "*especially the ones [tasks] that take investigation [C3 Scrum Master]*". This was due to the complexity of the task or lack of information from other team members or customers, which resulted in postponing decisions. "*If we cannot do anything then generally we postpone the task because it cannot be done [C3, Developer 1]*". In C1 and C4 team members were transferred from the team or left the organization, resulting in the departure of valuable sources of information from the team, which was problematic for decisions. But, sometimes there was "*no real way of getting around that [C4, Developer 5]*" and the team decided to reallocate tasks to the most appropriate member.

- *Time Constraints*

The teams worked in short intense cycles, which placed time pressure on teams during the SPM and DSM, affecting the second and third phases of the decision-making process. The time available to complete work was limited with decisions on the allocation of tasks and estimates made during the SPM. At the SPM the short timeframes made it difficult for teams to decide how large tasks (e.g. design tasks) could be incorporated into a sprint as *"you have such a short perspective in everything [C2, Developer4]"* with all tasks typically broken down into small tasks of a few hours or days. In C2 this resulted in a decision to exclude larger tasks from the sprint and the delegation of work to an individual outside of the team. The short timeframe of a sprint also put teams under pressure "*to get stuff done,*

which leaves no time to think of the long-term [C3, Product Owner]" and in C1 resulted in the allocation of work to those who could complete it in the shortest timeframe in order to achieve a deadline.

Since the introduction of Scrum some team members in C2 regularly found themselves working overtime to meet deadlines. Consequently, team members occasionally made personal decisions in the SPM to reduce their effort in a sprint because they felt overworked in previous sprints: "*The last sprint…I had a very soft sprint…I did that on purpose because I thought I had worked a lot before [C2, Developer3]*". On the other hand in C4, team members focused on giving accurate estimates because *"if you get it wrong….you work late" [C4, BA]* because they felt pressure to complete the sprint. On occasion developers also made personal decisions in a DSM to understate the work that was completed: "*When I report I generally go a little bit more negative than what I find the current status…because once you set the expectation that's the norm so you are better off not setting the bar too high so if you do get in ahead of time, you know you are doing better than the norm rather than the other way around [C2, Developer 7]*". Underestimating tasks may have occurred when team members were under pressure and worked overtime and felt they could reward themselves by reducing their effort in the next sprint.

- *Influence of experts*

Certain individuals had undue influence on the team due to their experience or seniority within the team, which had negative repercussions in the SPM for the third phase of the decision-making process when selecting the most appropriate solution. The person with the most knowledge tended to influence the decision and team members usually did not question it: "*It's usually the one that has the knowledge to take the decision that suggest okay we do it like this, and then everyone else accepts it [C2, Developer 4]*". This also occurred in C3 where individuals, even though they were experienced, were slightly intimidated and felt they could not question an expert's decision: "*If you disagree with what people with more experience said, you are little bit in a difficult time and you start doing what other people ask [C3, Developer 3]*". In C4, inexperienced team members felt that the senior members *"don't like being told what to do" [C4, Developer 3]* and were reluctant to verbalize their opinions, resulting in a lack of collaborative decision-making since the junior member was not contributing.

DISCUSSION AND CONCLUSION

This study provides an insight into the decision-making process and the factors that negatively influence decision-making in two agile team meetings across four teams. Each team structured the meetings to suit their specific needs, which is unsurprising given that many teams tailor agile methodologies/practices (Fitzgerald et al., 2006; Law and Charron, 2005). The findings are therefore not generalizable to all agile teams, but are specific to the four teams studied.

The two meetings studied are critical for decision-making in APM teams because they are forums where team members regularly communicate, are informed of progress, and make key decisions. The results show that where tasks are not well understood, specific phases of the linear decision-making process are used. APM teams only follow the linear decision-making process (Figure 1) in the SPM and the DSM where tasks are well understood and familiar to the teams. The findings also show a number of factors that inhibit the use of the linear decision-making process, which may impact on the performance of the team or the ability of the team to deliver agreed functionality.

The linear decision-making model (Mintzberg et al., 1976) does not always apply to decisions made during the SPM and DSM. During both meetings, the problem identification phase takes place as APM teams recognize that decisions are required. Once they move to the second phase, if ready-made solutions exist, they move to the third phase to evaluate these options, selecting one to implement. Their experience helps drive this process for repeat decisions, e.g. selecting tasks and making estimates in the SPM or deciding how to resolve smaller issues in the DSM. The decisions requiring new solutions, as opposed to ready-made solutions, are where the model (Mintzberg et al., 1976) is hindered. These decisions require research spikes or additional workshops to discuss and decide how to develop functionality. Likewise, the DSM is so short that often decisions regarding issues are made quickly or postponed to additional meetings where different options are discussed and decisions made for how to progress.

An objective of this paper was to explore whether a linear decision process was used, and as the data indicate, a linear decision model does not seem appropriate for APM. APM teams implement tailored agile practices (Fitzgerald et al., 2006; Law and Charron, 2005), and it also seems that as these methods transition away from traditional SDT practices, so too does their decision process transition from a rigid, linear process to a more

adaptable one. The APM cases studied used their experience in repeat decisions so APM decision-making seems a more flexible decision method that may be akin to naturalistic decision-making where experience drives decision-making (Zsambok, 1997), as proposed by related research (Drury, Acton, Conboy and Golden, 2011).

This research contributes to project management by providing an insight into the decision-making process in two meetings. Where the Scrum roles are present, the team follows the linear decision-making process for familiar tasks in the SPM. But, if teams use the SPM to decide how to address complex functionality, the linear decision model is not used as these complex tasks require more information gathering and discussion, which take place in separate meetings to more accurately determine tasks and estimates, the outcomes of which are incorporated into the next SPM. However, a key finding is that APM teams are missing key information for decisions because resources are either not participating in complex functionality decisions due to thinking that their inexperience precludes them from doing so or resources are pulled from teams from one sprint to the next. As APM already uses less documentation than traditional SDTs (AgileAlliance, 2001), they are making decisions with incomplete information and the very nature of agile cannot mitigate this risk because there is no documentation to fall back on when resources are pulled from the team mid-sprint. This suggests that agile methodologies may not be suitable for projects that contain a large number of unknown, complex tasks as it is difficult to make informed and accurate decisions in SPM's due to a lack of knowledge. Also, these additional meetings were not the focus of this study. Further, during the DSM team members provide a brief update of progress, issues and next tasks. Sometimes time pressure leads to quick decisions that may not be appropriate or may lead to overestimating or underreporting progress of tasks to temporarily reduce a member's workload. We recommend that teams avoid reducing their efforts as they may have to re-address the issue in the future if solutions are neither properly discussed in sufficient detail. These decisions impact the team's overall ability to deliver on their goals especially if overestimating and underreporting are regular occurrences. As teams make decisions it is important that such behaviors, if known, are not accepted and are addressed by the team.

Additionally, much agile research focuses on the positive aspects of agile methodologies (Cockburn and Highsmith, 2001; Conboy, 2009; Conboy and Morgan, 2011), even when discussing APM challenges (Nerur et al., 2005; Boehm, 2002) with little focus on difficulties that teams face in practice. Some research has begun exploring obstacles to agile decision-making, including conflicting priorities, lack of commitment, inconsistent resources and lack of empowerment (Drury, Power and Conboy, 2011). This current paper further contributes to APM by identifying seven factors that negatively affect decision-making during the SPM and DSM. All seven factors affected the SPM (team distribution, resource drain, customer involvement, estimation process, level of experience, time constraint, and influence of experts), with three of them (team distribution, resource drain and time constraints) also affecting the DSM (see Figure 2). These factors could be a result of tailoring Scrum to suit the team's particular needs as APM teams do not necessarily implement Scrum as defined by the methodology. APM teams often select what agile practices they implement. From a project management perspective it is important to understand the factors that influence the decision-making process in such meetings and to help understand how decisions are made that may impact the outcome of a sprint or a project. This study highlights such factors and also contributes to the literature on how these meetings are implemented in four APM teams.

LIMITATIONS AND FUTURE RESEARCH

The study was limited to an investigation of one agile methodology and two agile practices, which was deliberate to bound the study and to allow for an in-depth examination of two specific meetings and how they influence decision-making in APM teams. Decisions were also made outside of the meetings studied but these were not explored in this research, which is a further limitation and should be considered for future research. Thirdly, the views presented in the findings are solely representative of the teams studied. Finally, the number of observations was limited in each of the cases studied and the study may have benefited from additional observations over a longer period of time. Future research should also consider other agile methodologies and practices and how they influence the decision-making process in APM teams, particularly complex projects where a large number of tasks are unknown. It should also examine other teams, both co-located and distributed and the cultural implications, or multiple teams within the same organization to investigate if similar findings are evident.

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APPENDIX

This appendix details an excerpt of the interview protocol. The protocol included general demographics information such as years of experience with software development and agile methods, role, team size, team location, length of sprints, length of project, and agile method and practices used. Questions specific to decision-making included:
1. In a few short sentences, can you explain how your agile team makes decisions?
a. During the SPM?
b. During the DSM?
2. How do you decide your estimates?
3. How do you decide to whom to assign tasks?
4. How do you decide which tasks go in this sprint versus a later one?
5. What factors or issues prevent your team from making decisions during SPMs?
6. What factors or issues prevent your team from making decisions during DSMs?

Table 3. Interview Protocol Excerpt