Decision Making in Agile Development:
A Focus Group Study of Decisions & Obstacles

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Abstract— **The process and effectiveness of decision making in agile development is critical yet poorly understood. This research examines decisions made across the four stages of the sprint cycle: Sprint Planning, Sprint Execution, Sprint Review and Sprint Retrospective. A focus group was conducted with 43 agile developers and managers to determine what decisions were made at different points of the sprint cycle. The results indicate that Sprint Planning includes decisions about planning the work for the subsequent sprint, Sprint Execution includes tactical implementation and development decisions, Sprint Review includes decisions about whether the product satisfies the customer and whether future sprints should continue, and Sprint Retrospective includes decisions for improving the sprint process in future sprints. Additionally, six key obstacles to decision making were identified. This research contributes to the literature on agile software development by advancing our understanding of how these teams function by analyzing the decisions made during different points of the sprint cycle and the obstacles to these decisions.**

Keywords-component; sprint decisions; decision making; sprint planning; retrospective; decision obstacles

I. INTRODUCTION

Agile software development (ASD) teams are involved in critical decisions that underpin ultimate project success or failure, and these teams exhibit characteristics that affect the nature of their team's decision making, compared to traditional methods of software development [1-2]. ASD teams deliver working software in short iterations, which results in more frequent, short-term decisions [3-4], and value working software over documentation [3]. The project manager's role as a decision-maker is greatly reduced [5-6], developer's roles interchange and blend to such a degree that developers may make decisions outside of their traditional skill areas, and the customer or Product Owner plays a continuous and embedded role, intrinsically involving them in many decisions [7]. These issues require an analysis of decision making in an agile software development context, a context that is more flexible than and differs from traditional software development where there is an accountable project manager, clearly defined and specific roles for team members, and documentation used to drive decisions.

However, little is known regarding decision making in ASD teams. Some research has found that ASD team members rely on their experience to determine whether a design decision is necessary [8] and then compare options when making design decisions [9]. Attempts have been made to develop a model of how ASD teams make decisions, relying on rational decision methods when the design problem is more structured and on naturalistic methods when the design problem is less structured [10]. Yet there is no definitive model defined outlining the decisions ASD teams make and when they are made.

While there are many decision making theories and frameworks in existence (e.g. rational decision making [11-12], normative decision theory [13]) we adopt Descriptive Decision Theory (DDT) as the theoretical lens for this study because DDT focuses on how 'real people think and behave'[13]. This is highly suitable for exploring the flexible ASD context because it calls for the researchers to describe the actual decision situations within a sprint, including what decisions are made and when. The research objectives of this study are therefore to:

1. Develop an understanding of the tactical and strategic decisions made in ASD teams using.
2. Identify the obstacles to these types of decisions in ASD teams.

II. DESCRIPTIVE DECISION MAKING THEORY

Decision making was traditionally viewed as a rational process: people followed clearly defined, sequential steps to make optimal decisions by weighing options. This process assumed decision makers were fully informed and rational, and problems were well-defined with a variety of informed, alternative solutions [11-12]. This rational decision making (RDM) method is a normative theory: it describes how decision makers should think and should act based on coherence and rationality. Normative decision theory views decision makers as idealized, rational, extremely intelligent beings who overcome their inner turmoil, shifting values, anxieties, post-decision regrets, fear of ambiguity, inability to perform intricate calculations and limited attention span to make rational, optimum choices [13]. RDM looked at optimal ways of making decisions between choices of alternatives in well-structured settings [14]. However, researchers admitted that when making decisions in real-life situations, they

were not generating multiple options and comparing them on a set of evaluative criteria; they did not generate probability estimates for diffeent options; and when they did compare options, they were not doing so in a systematic way [15].

As a result, there was an effort to understand decision making in real-world situations because researchers realized that actual choice can differ from prescribed choice [16]. Whereas normative decision theory prescribes the choices a rational person should make in a given situation, DDT focuses on the actual choices made in a given situation, on how and why real people think and act in the way they do in given situations [16]. DDT is concerned with how people perceive uncertainties, collect evidence, learn and adapt behaviors and perceptions, and deal with internal conflicts and complex problems. It does not look for mathematical axioms or ways people should make decisions. Rather, DDT looks to explain how people make decisions in a given context [13].

Therefore, to understand the decisions on ASD teams, the authors believe that it is important to study the actual decisions ASD teams make using DDT because this theory focuses on defining the actual choices made in a given situation and how and why decision makers made them [16]. As team members' roles interchange and they are often involved in decisions outside of their traditional skill areas [7], we will define both the tactical and strategic decisions they make. Tactical decisions are defined as those that refer to the day-to-day activities that maintain efficient and smooth operations [17] of developing and testing software functionality. Strategic decisions refer to those decisions concerned with the long-term health of the organization [17]. Typically, software development teams would be involved in tactical decisions, and it is unclear whether ASD teams also make strategic decisions, in addition to tactical ones, as these teams involve their members in all decisions [5-6].

A. Periods of a Sprint in Which Decisions Occur

Decision making in any project incorporates a broad range of issues and occurs during many different activities and events. To bound the research, this study uses DDT to determine the actual decisions made during a typical sprint. We use the term 'sprint' rather than 'iteration', though the discussion is equally applicable to agile processes other than Scrum. A sprint is a time-boxed period of fixed length [18-19] that starts with a Sprint Planning Meeting and ends with a Sprint Review and Retrospective Meeting [18]. In between the Sprint Planning Meeting and the Sprint Review is the Sprint Execution where the team works on delivering software that meets the sprint goal [18]. For the purposes of analyzing the decisions made in a sprint, the authors consider these four periods and associated activities described below and visualized in Figure 1.

Sprint Planning: Sprint Planning is the meeting that marks the start of each sprint. It consists of a set of activities that will plan the work for the ASD team in the upcoming sprint [18].
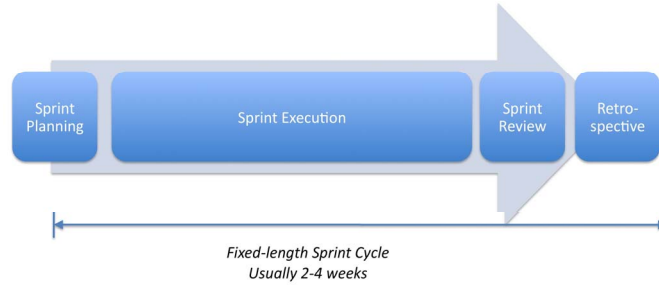

Figure 1. Decision Making Periods in a Sprint Cycle

Sprint Execution: Sprint Execution is the period of time between the end of the Sprint Planning meeting and the start of the Sprint Review. Sprint Execution is the time when the team works on the actual product to meet the Sprint goal. The software, i.e. product, is developed and tested here [20].

Sprint Review: The Sprint Review is typically a meeting that involves the team plus any invited stakeholders and other interested parties. The Sprint Review focuses on the work the team has completed during the sprint, comparing the commitment at the start of the sprint to the actual delivery at the end of the sprint. A Sprint Review will generally include a demo of the running, tested software that has been developed in the sprint [18].

Sprint Retrospective: Sprint Retrospectives are an opportunity for the team to reflect on how it is working together and actively seek out areas to improve. The Retrospective is a facilitated session at the end of the sprint [21].

III. RESEARCH DESIGN

To identify the decisions that ASD teams make during a typical sprint and associated obstacles to making these decisions, a qualitative approach was employed where the unit of analysis was a focus group comprised of 43 practitioners from 36 different companies. Focus group research emerged from work performed by Paul Lazarsfeld, Robert Merton and colleagues at Columbia University in the early 1940s. It is defined as a "research technique that collects data through group interaction on a topic determined by the researcher" [32] and involves a group of participants and one or more moderators. The core theoretical elements of focus groups include topical focus, group interactions, in-depth data and a "humanistic" character [33]. The focus element derives from participants of the group having a "particular concrete situation" in common [34] providing a basis for effective communication but is also affected by the moderators direction of the groups discussions. The researchers guide discussions with suggested topics and probing, open-ended questions.

However, the "hallmark" of focus groups is the group interaction through which insights and less accessible data can emerge which may not otherwise come to the surface. Researchers [35-36] draw attention to the importance of

this differentiator of focus groups from other forms of collective or focused interviews – that is, group interaction and discussion. This aspect is especially true where participants may not know much about the research topic or require a group discussion to stimulate them to make a contribution [32]. Merton and Kendall [34] refer to this as "introspective retrospection" while Bloor, Frankland et al. [37] refer to the ability of participants to "articulate those normally unarticulated normative assumptions." In drawing out such contributions, Kitzinger [35] goes so far as to suggest shared tasks and games to encourage group interaction and advocates the analysis of differences and agreements within the group as very valuable. Therefore, in some ways focus groups could be considered to lie between dyadic interviews and direct observation: while allowing the researcher to direct attention to specific topics as allowed by interviews, they also facilitate group discussion as per observation.

As well as the richness of data collected, another significant benefit of focus groups is the ability to get much data from a group in a short amount of time [32-33]. It allows participants to probe other participant's reasons for their viewpoints, even challenging other's viewpoints, which allows issues to surface that the researcher might not have asked [22], which makes them appropriate for exploratory research such as this study. This focus group provided the researchers with an opportunity to explore the varying viewpoints of practitioners who worked on different ASD teams.

A. Focus Group

The focus group consisted of a group of 43 software industry agile practitioners. This was a larger number for a focus group, although larger focus groups are recommended for topics where researchers want to collect multiple brief comments and suggestions, whereas smaller focus groups are recommended when researchers want to collect more detailed commentary or discuss complex or controversial topics [38]. As this research is at the early stages of understanding decision making on agile teams, a larger group was preferred to obtain multiple brief descriptions of the decisions rather than detailed discussion on the complexities. Participants in the focus group were attendees at a professional software development conference with 1400+ attendees. They self-selected to attend this session with a choice of 20 other sessions offered at the same time. While this is a limitation of the focus group, it does provide a focus group with participants focused on improving their decision making and thereby a viable group to discuss current ASD decisions and obstacles. As can be seen from Table 1, the participants have a range of experience as some were beginners with agile methods while others have been working with agile for up to 10 years. They have diverse backgrounds with varying industry sector experience with agile development. The focus group was hosted in the USA, but attendees came from the USA, Canada, Sweden, Denmark, Germany and the UK.

TABLE I. PROFILE OF FOCUS GROUP ATTENDEES

Criteria	
Number of Participants	43
Mean Experience with Agile Development	2.90 years
Standard Deviation of Agile Experience	2.14
Least Experience with Agile Development	4 months
Most Experience with Agile Development	10 years
Industry Segments	Communications
	Consulting
	Entertainment
	Finance
	Government
	Manufacturing
	Media
	Software Product Development

B. Data Collection and Analysis

The structure of the focus group was an exercise and open discussion on decisions made during particular periods of a sprint. Specifically, the following topics were covered:

- Importance of decision making for agile teams
- Decisions participants make in the four agile periods
- Participant perceptions of the obstacles to decision making during the four periods of the sprint cycle
- Issues related to decision making (to flesh out any other obstacles)

After a brief presentation on the importance of decision making for agile teams, the participants divided into ten teams to conduct the decision making activity in an agile manner. The goal was for each team to produce a set of decisions that they make at each of the four periods in a sprint cycle discussed earlier. The researchers had previously prepared four blank posters on the wall, one for each sprint period discussed. Like in a Sprint Planning meeting, participants from each team wrote decisions on Post-It™ notes as they would write sprint tasks. They organized these decisions to fall into one of each of the four sprint periods. They then had to place their Post-It™ notes with decisions on the correct sprint period poster (see Figure 2 and 3). After the participants had completed this activity, the researchers facilitated the focus group discussion on the decisions made in each period and the participants' perceptions of the obstacles for agile team decision making. Although it was a large group, this resulted in a very lively and engaging discussion. Issues related to decision making were also briefly discussed during this focus group session to discern any other obstacles not already discussed.

The questions during this focus group were largely open-ended, allowing respondents freedom to convey their experiences and views [23-24], and expression of the socially complex contexts that typically underpin software development. The focus group was conducted in a responsive [25-26] or reflexive [27] manner, allowing the researchers to follow up on insights uncovered mid-

a. Faces have been covered to protect participant confidentiality

Figure 2.   Determining the Decisions Made in Each of the Four Periods in a Sprint

Figure 3.   Resulting Posters of Decisions Made in Each of the Four Periods in a Sprint

session, and adjust the content and schedule of the focus group accordingly.

To improve the reliability and repeatability of the research, a traceable, 'audit trail' of the research process, from data collection through to the drawing of conclusions, was sought. A focus group protocol was prepared based on the four sprint periods, specifically Sprint Planning, Sprint Execution, Sprint Review and Sprint Retrospective. These provided a list of "intellectual bins" or "seed categories" [28] to structure the data collection and the open coding stage of data analysis. While one researcher facilitated the session, another listened, observed and took notes. The researchers then switched roles to account for any variance between their note-taking and questioning. In any cases of ambiguity, clarification was sought from the attendee during the focus group.

In order to aid analysis, the focus group was recorded and transcribed, generating a total of 12 pages of data that were then proof-read, annotated and coded by the researchers using NVivo. The data (i.e. decisions and obstacles) were also emailed to all participants for feedback and validation. No participants sent edits or changes to the data, except to comment on the usefulness

of having the data for their work at their own organizations. Subsequently, vetting was used, whereby results and interpretations are discussed with professional colleagues to avoid the problem of what Kaplan and Duchon [29] call multiple realities.

Data analysis used Strauss & Corbin's [30] open coding and axial coding techniques. Open coding is "the process of breaking down, examining, comparing, conceptualizing, and categorizing data" [30]. Glaser [31] argues that codes and categories should emerge from the data, while with Strauss & Corbin's approach [30] these are selected prior to analysis. The approach adopted in this study is more akin to the latter, where the focus group questions and subsequent analysis were based on DDT theory to understand the actual choices made in a given situation [15]. These provided a list of "intellectual bins" or "seed categories" [28] to structure the data collection and the open coding stage of data analysis.

The second phase of analysis used axial coding. Axial coding is defined by Strauss and Corbin [30] as a set of procedures whereby data are put back together in new ways after open coding; whereas open coding fractures the data into categories, axial coding puts the data back together by making connections between the categories

and sub-categories. Once the decisions were categorized and consolidated by sprint cycle, they were also rearranged to define the tactical and strategic decisions. At this point, the categories were deemed to be "theoretically saturated" [30].

IV. ANALYSIS

A. Decisions Made in Each Agile Period

This section explores the particular decisions that participants reported they made at each period in the sprint cycle. We categorize the decisions they make during the sprint periods as either tactical or strategic decisions. Table 2 provides a summary of the decisions that were discussed for each period in the sprint cycle.

1) Sprint Planning

Participants reported that decisions made during Sprint Planning are forward-looking, though they are made with little information and many unknowns. One participant observed, *'We're making bigger guesses than we will when we start working. When we estimate a story, there's a lot of unknown. As we start to work on a story, we learn more and more about it'*. This is not surprising as this meeting determines the activities to take place in the subsequent sprint. Therefore, participants quoted such decisions during this period as *'Determine sprint goals', 'Decide who is the owner of the story', 'Decide who will work on what',* and *'Determine if user stories require more discovery work'*. These quotes indicate tactical types of decisions to plan what work will be completed during the subsequent sprint and who will do it. The only strategic decision coded during Sprint Planning related to priorities of the sprint (e.g. *'Determine priorities for sprint'*) as this decision affects the sprint delivery for this and future sprints, which affects the long-term ability of the organization to deliver to its customers.

Participants also noted that many of the decisions are group decisions, meaning they make them together rather than as individuals. This group decision making requires discussion and agreement from all team members. It seems to be used most for deciding the approach for development. Examples of these group decisions included, *'Decide the approach to delivering the story', 'Decide to split or combine user stories',* and *'Decide the approach to delivering the story'*.

However, while participants could list out the decisions made during Sprint Planning meetings that focused on tasks, task owners and estimations, there was less clarity on the timing of planning decisions for design as to whether they should be planned during the Sprint Planning or allowed to emerge during Sprint Execution: *'Where does the design decision come in? Because we find we take a lot of technical decisions during Sprint Execution and to me that's a little dangerous ... and I know agile says design is emergent ... So how do you get confident because you say "Well, ok, team we've got 2 weeks so let's do this" and then 2 weeks later it's like "Oops" ... How do you get*

past that?' There is uncertainty as to design decisions, and while the agile philosophy is for emergent design, it does seem like there would be value in planning out some tasks related to design to account for team members' time spent on this activity.

2) Sprint Execution

Participants asserted that Sprint Execution is the tactical period of development and testing compared to Sprint Planning, which plans the activities for the sprint. Participants stated, *'Execution is more about adjustments'* and *'Execution is more tactical'*. Thus, decisions during Sprint Execution focus on the actual development of functionality and how to do it as teams: *'Determine how to implement functionality', 'Decide on the architecture/design for functionality', 'Define when a feature is "Done"', 'Decide the interface design',* and *'Decide what tests to create'*. These decisions all focus on the practicality of how to develop and test the functionality that teams have planned in Sprint Planning to complete for this sprint.

Decisions made in this period are also generally closest to when those decisions will actually be implemented, so participants can make more accurate judgments. As discussed during the Sprint Planning, team members make bigger guesses during the planning meeting because they have less information since they haven't started to develop a piece of functionality yet. But, during Sprint Execution, *'we start to work on a story, we learn more and more about it'*. Therefore, some decisions during Sprint Execution are strategic because they address changes to scope as team members gain more information by developing functionality compared to when they were planning the sprint. Examples of these decisions include, *'Decide whether the sprint scope should be changed (i.e. reprioritize tasks, accept new tasks)',* and *'Decide whether to add/remove/or change acceptance criteria'*.

3) Sprint Review

During the Sprint Review meeting, stakeholders have an opportunity to review progress and determine whether it is worth proceeding. Based on customer feedback, the ASD team decides whether the functionality meets customer expectations, whether estimates need to be modified, what stories should be prioritized for the next sprint or whether to stop development. A number of participants reported having worked on projects that were cancelled after 2-4 sprints because it became clear the project could not achieve its goals. This was seen as a positive outcome because the business avoided investing further in an area that was not going to be profitable. Participants said the decision to stop development occurs during Sprint Reviews: *'It [the Sprint Review] shows visibility on the problems we had and the decisions we made. It didn't make sense going forward with more sprints'*. Other participants stated, *'Ah, it [stopping development] happened twice...it was in the early stages – in the 3rd or 4th sprint'* and *'It happened once in an early sprint where we were trying to figure out how much it would cost us'*. The decisions to *continue the project* and *what stories and defects should be scheduled for next*

TABLE 2 DECISIONS MADE IN SPRINT PLANNING, EXECUTION, REVIEW AND RETROSPECTIVE PERIODS IN THE SPRINT CYCLE

Decisions Made	Tactical	Strategic
Sprint Planning		
Decide sprint goals and scope (user stories and tasks)	X	
Decide priorities within sprint		X
Decide which people will be available	X	
Decide capacity for team members	X	
Decide who is the owner of a story	X	
Decide who will work on what	X	
Decide task estimates	X	
Decide if user stories require more discovery work	X	
Decide definition of when a story is 'Done' (i.e. completed)	X	
Decide to split or combine user stories	X	
Decide the approach to delivering the story	X	
Sprint Execution		
Decide whether sprint scope should be changed (i.e. reprioritize tasks, accept new tasks)		X
Define when feature is 'Done' (i.e. when to accept/reject story)	X	
Decide who will pair together for paired programming	X	
Decide the interface design	X	
Decide how to implement functionality	X	
Decide when to commit code	X	
Decide what tests to create	X	
Decide whether to add/remove/change acceptance criteria		X
Decide on the architecture/design for functionality	X	
Sprint Review		
Decide if delivered product meets customer expectations	X	
Decide whether story estimates need to be modified	X	
Decide whether to continue with the project		X
Decide whether to accept the sprint content	X	
Decide what stories and defects be scheduled for next sprint, particularly if not completed		X
Sprint Retrospective		
Decide what to improve during the next sprint	X	
Decide what went well to continue during next sprint	X	
Decide what new things team will try in next sprint	X	
Decide root cause if team did not meet its sprint goal	X	
Decide priorities for things to address in future sprints		X
Decide issues that will most influence team success		X
Decide whether and how to measure team metrics		X

sprint are strategic because they affect what the overall organization can deliver to customers.

However, it seems not all decisions to stop development occur in the Sprint Review meeting and some do occur during Sprint Execution when teams gain more information about functionality as they begin to develop as another participant counter-argued: '*We had a little different situation and it wasn't as clean as just being in a Sprint Review meeting. But we were maybe 75% of the way through the project and saw that we couldn't deliver the majority of the value and saw that remaining stories wouldn't really deliver that much for the business so we decided to go to market [with what we had]*'. This team recognized that the cost for developing additional stories wasn't worth it because the stories wouldn't add that much more value to the customer, so they made the decision to go with what they had at that time.

4) Sprint Retrospective

The majority of feedback for the Sprint Retrospective confirmed that teams use this activity to make tactical decisions about process, specifically around short-term improvements. One participant described the Sprint Retrospective as '*another opportunity at the retrospective to say 'where do we want to improve?*. It is also the period within the sprint where more strategic decisions are made compared to any other period as team members decide and prioritize improvements for future sprints which could impact the overall organization and its customer relationships. Examples of specific tactical decisions include, '*Decide what to improve during the next sprint*' and '*Decide what went well to continue during next sprint'*. Strategic decisions focus on future priorities and tracking team success. They include: '*Decide priorities for*

things to address in future sprints', '*Decide issues that will most influence team success*', and '*Determine whether and how to measure team metrics*'. Regardless of being tactical or strategic, all of these decisions indicate the team uses the Retrospective to decide how to better their teams' agile process in future sprints. They even consider the priority of some improvements, which makes for an interesting future research project.

Yet while some participants view the Sprint Retrospective as an opportunity to discuss lessons learned and to improve future performance, not all participants shared a similarly positive experience. Another participant had a less positive experience with retrospectives in their team: '*In my experience it seems to be just a free-for-all of just throwing positives and negatives on a wall and grouping those, you know, if two people say the same thing we talk about it. There's not really a lot of decisions to be made other than, saying, 'alright here's one…*'' Therefore, it seems there is a danger that teams just vent frustrations during the Retrospective rather than make decisions and implement those actions for improvements in future sprints, of which teams should be wary.

B. Obstacles to Decision Making in Agile Teams

The focus group participants also discussed a number of obstacles from their experiences across all four periods of the sprint cycle.

1) People are Unwilling to Commit to a Decision

Lack of commitment to a decision was an issue raised by many. In some teams nobody was willing to make a decision and resolution was left to the Scrum Master, coach, or managers who then faced a decision point – either make decisions on behalf of the team, or stand back and allow the team's confidence to emerge. Of the list in Table 2, architectural decisions and measurement decisions were often cited. Lack of commitment regarding the former was typically due to a lack of sufficient expertise, while commitment regarding the latter was due to the diverse metrics that could be applied and the significance of choosing one metric over another, e.g. one metric may be better but have a negative impact on perceived developer or team performance. Evidence of a lack of commitment was varied; in some cases delayed decisions were a clear signal. In one humorous instance developers were often seen to be moving index cards half way between columns on the whiteboard, showing that a story was somewhat complete but that the developers were unwilling to take the decision to declare a story fully complete.

2) Conflicting Priorities

When faced with multiple customers with multiple, often-competing requirements and priorities, it can be tough to make any decisions on scope, content and priorities. This was felt to be particularly relevant to agile. As one participant stated, '*with more plan-driven approaches everybody has a clear role and a clear line of command and so people whose priorities conflict are somewhat separated horizontally or vertically*'. In an agile context, the team hierarchy is flat '*and so all people and all their conflicts are clustered together*'. This affects the strategic goal as it becomes unclear as to which of all of these priorities actually takes priority, and that comes down to overall organization's goals.

3) Inconsistent Resource Availability During Sprint

During a sprint, people can be pulled onto other projects with little or no notice during Sprint Execution. This can happen for a variety of reasons, but the common reason in the focus group was developers being pulled to deal with customer support issues. This was seen as particularly problematic in an agile context where the scope of the sprint was decided based on team members' task estimations with no allowance for slack. Many noted that the external tasks often get priority over the prioritized list of project requirements: '*When the CTO rings you cannot tell him or her to wait for the next prioritization to book a developers time*' (participant who stated he was a Project Manager). When a participant is pulled to external tasks, the sprint cannot be completed on time as a result.

4) Decisions are Not Implemented

An environment where decisions do not result in implementation can create an atmosphere where people stop making decisions. As one participant noted '*I'm just going to let someone else make the decision for me because whatever I decide to do just didn't go anywhere anyway*'. While decisions regarding user stories and their estimates were not typically associated with this, some pointed to agile as the cause of many decisions '*petering out*'. As one developer noted '*we make decisions in the planning meeting but then at the end of the sprint, you find out that somebody rubbed out or changed that item on the whiteboard, based on some chat that we weren't involved in*'. There was a sense from quite a few participants that while some decisions in an agile environment are clearly documented and tracked, the informal, co-located, social nature of agile can result in subtle changes in decisions, and while this is sometimes positive, some staff take follow on actions based on decisions that they were unaware had changed.

5) Lack of Ownership

Participants reported cases where the team makes a decision but nobody really took ownership of seeing it through. A few participants in particular spoke of teams with a significant number of 'weaker' developers, where decisions were very easy to reach, but the implementation of those decisions left a lot to be desired. Interface and implementation decisions were considered particularly susceptible to this, as one participant stated '*we wouldn't have made that decision if we knew it was going to be executed poorly and nobody was going to stand accountable*'.

6) Lack of Empowerment

This obstacle relates to a lack of empowerment to make decisions, but also to follow through on executing against those decisions. Ultimately, people like to be involved in the decision making process. Empowerment and involvement in decision making is often seen as a core strength of agile. However, some felt that decisions they

traditionally had control over disappeared with the transition to agile: '*While I got advice, I was always the person with the final call on anything architecture related. Now with this democratic environment, I am only one voice among many, and many of those know very little regarding architecture*'. Thus, in ASD, people can be involved in decisions that fall outside their remit, thereby potentially lessening the voice of the knowledgeable and expert team members in that particular area.

V. Conclusions

To better understand the actual agile decisions made in the real-life situation [16] of an agile environment, this research examined the different decisions made across four periods in a sprint cycle: Sprint Planning, Sprint Execution, Sprint Review and Sprint Retrospective. The results indicate that agile teams do focus more on tactical rather than strategic decisions. A likely explanation is that working in sprints gives the team a short-term, two week focus. Because of this, teams can lose sight of the organization's goals for customer delivery and how their decisions fit into these goals. Sprint Planning includes decisions about planning the work for the subsequent two week sprint. Sprint Execution includes tactical implementation and development decisions, including adjustments needed to the scope of the sprint as teams acquire additional information while they are developing functionality. Sprint Review includes decisions about whether the product satisfies the customer and whether future sprints should continue. However, the data indicate that sometimes the decision to stop development also occurs during Sprint Execution when the value of developed functionality is ascertained. Finally, the Sprint Retrospective includes decisions for improving the sprint process in future sprints, although the data also indicate that not all teams implement said improvements. To some, the Retrospective appears a waste of time because people just talk about issues but no one takes them on board to make changes in the process in future sprints.

The goal of DDT is to understand actual choices and why they are made in a given context [13] and this research indicates that people make decisions in the context of these four agile periods based on the goal of each period. Sprint Planning plans the work of the sprint [18], Sprint Execution does the development and testing [20], Sprint Review gives a product demonstration and discusses customer satisfaction [18], and Sprint Retrospective reviews improvements for future sprints [21]. Throughout the sprint cycle, decisions therefore move from planning the sprint, to tactical implementation, to customer satisfaction, to sprint improvements.

This is not surprising as a project generally requires decisions for planning, tactical work and review, but what is important to understand is how the obstacles can affect agile development. *Conflicting priorities* make it difficult for agile teams to focus on decisions for planning the two week sprint, which is a short period of time particularly for juggling multiple priorities. The short focus of sprints puts less emphasis on long-term strategic decisions and more

focus on the short-term tactical decisions for two weeks. Planning the work requires estimation for tasks for each team member during the sprint. When there is *inconsistent resource availability during the sprint*, this planning falls apart and the basis of the sprint disappears. While teams may believe they can recover in future sprints as the incomplete work was just from a two week period, these unfinished tasks can build quickly and steadily over time as resources are continuously pulled form agile teams, thereby delaying future sprints..

The obstacles make Sprint Execution and Sprint Review difficult as well. One of the purposes of agile is to involve team members in all facets of development [7], but when *people are unwilling to commit to a decision,* they do not make decisions and rely on the scrum master to do so. This lessens the autonomy of the team rather than engages all members. Likewise, when *decisions are not implemented* and there is a *lack of ownership*, people might be making decisions but are not following through with quality work. Or, a *lack of empowerment* hinders the knowledgeable people from making decisions to allow other less knowledgeable people make them. The functional delivery at the end of the sprint suffers and customer satisfaction may be reduced during the Sprint Review as a result.

While this study examined ASD professionals with various experiences, a future, in-depth study of 1 – 4 ASD teams as case studies would provide detailed descriptions of the complex decision making process on these teams. This focus group did not explore people making decisions in their actual ASD team environments so there is no observation or individual interview data to triangulate with the focus group findings. Whereas this focus group did provide insight by asking team members to describe the decisions and obstacles on their agile teams, future research should include these other in-depth methods of data collection to fully conform with the application of DDT by observing people in their actual decision environment. For example, members of this focus group focused on their tactical decisions with little mention of strategic decisions. Observation of ASD teams could reveal whether ASD teams are involved in making strategic decisions or whether these teams remain focused on the day-to-day activities to deliver working functionality each sprint like the focus group stated.

A lack of clarity as to when design decisions take place still remains as well. In this study, participants could not agree to whether design decisions should be planned upfront during Sprint Planning or allowed to emerge during Sprint Execution. Future observation and interview research is necessary to determine how to handle design decisions for ASD as participants cited this as a common problem.

Additionally, future research can examine the impact of the decisions across the four periods of the sprint cycle on the overall project performance. This study was an exploratory first step to determine when ASD teams make decisions and what obstacles prevent team members from making decisions. Looking at how decisions and solutions

to obstacles can improve project performance would help ASD teams improve their sprint delivery.

Nevertheless, this study has contributed to the ASD literature by identifying decisions made and obstacles during four periods of a sprint cycle which can now be explored for impact on project and team performance.

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