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RESEARCH PAPER

**“SOFTWARE PROJECT MANAGEMENT: THE ROLE OF SCRUM MASTER’S
IN SOFTWARE PROJECT PLANNING AND MANAGEMENT: ENSURING
AGILE SUCCESS: RELEVANCE, LIMITATION, AND NEXT STEP”**

TO

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ABSTRACT

Scrum reinvented the role of the scrum master in software development. In agile literature, the scrum master is envisioned as a "servant leader" who serves the team in a variety of ways, including promoting scrum, facilitating team functioning, and removing obstacles. However, empirical research on the role of the scrum master in practice is limited. To fill this void, a Grounded Theory study was conducted using a mixed methods approach, which included semi-structured interviews with 39 software practitioners and a questionnaire with 47 respondents. In this study, we present and describe the scrum master's role in agile projects in terms of (a) the grounded theory of the scrum master's role, which includes everyday activities such as facilitating, mentoring, negotiating, process adapting, coordinating, and protecting; (b) the scrum master's varying involvement in selected agile practices carried out by the team; and (c) a positive association between the presence of the scrum master and the frequency with which This study presents a multifaceted study of the multiple dimensions of the scrum master role for the first time, allowing practitioners to better manage expectations of this role in practice.

Keywords— grounded theory, mixed methods, scrum master, agile software development, agile project management, scrum, agile.

INTRODUCTION

A project is defined as a series of tasks that must be completed to achieve a specific outcome. The Project Management Institute (PMI) defines a project as "any temporary endeavor with a definite beginning and end." It can be managed by a single person or hundreds, depending on its complexity. Project management is the application of processes, methods, skills, knowledge and experience to achieve specific project objectives according to the project acceptance criteria within agreed parameters. Project management has final deliverables that are limited in time and budget. Project management software is used to plan, schedule, allocate resources, execute, track, and deliver software and web projects. It entails putting knowledge, skills, tools, and techniques to use to manage project activities, meet project requirements, and achieve project objectives. Software project management entails coordinating people, resources, and activities to create software products that meet the needs and expectations of customers.

Scrum was created in 1993 by Jeff Sutherland with the goal of becoming a development and management methodology that adheres to the principles of Agile methodology. Scrum is an additional responsive framework of software development for software projects and manage products or application development. The focus is on "strategy, a flexible holistic product development where the development team worked as a unit to achieve common goals" as opposed to "traditional approaches, a sequence". With the emergence in the late 1990s, agile software development introduced self-organizing teams to software engineering (Fowler and Highsmith 2001). Self-organizing teams have been characterized as teams displaying significant autonomy in taking decisions (Cockburn and Highsmith 2001) and managing workloads and allocating work among themselves (chow and Cao 2008), (Chagas et al., 2014).

In software planning and project management, the Scrum role is divided into three parts: Product Owner, Scrum Master, and Team. The Product Owner is the person in charge of determining the specifications or business of the software applications that will be built. The Product Owner will

document all the initial requirements that must be completed by the Team (known as the Product Backlog). The project team consists of business analysts, system analysts, developers, testers, and others. The team is responsible for completing the Product Backlog provided by the Product Owner, with members responsible for each Backlog that has been divided and capable of knowing what to do next. The Scrum Master is the person in charge of establishing the scrum process throughout the project. The Scrum Master will introduce and implement Scrum to the team, as well as ensure that everyone on the project is using the Scrum method.



Figure 1: scrum master role diagram

RESEARCH DESIGN

Our study utilizes an embedded mixed methods design, where both qualitative and quantitative strands are utilized to shed greater light on the research topic. The key difference between the embedded design and other mixed methods designs is the fact that one strand is dominant (for example, the study might be primarily qualitative in nature), and the other strand plays a secondary role (Creswell and Plano Clark 2011). In our study, it was the qualitative strand which was dominant and formed the backbone of the study. While the quantitative strand informed and supported the qualitative one in some respects, it essentially played a secondary role.

Depending on the type of mixed methods design used by a researcher, the level of interaction between the qualitative and quantitative strand can vary. As our study looked to understand the intangible aspects of the scrum master's role in agile projects, it was primarily qualitative in nature. However, it was felt by the authors that diverse data sets would allow a deeper insight into the research topic (Tashakkori and Teddlie 1998), (Creswell and Plano Clark 2011). Thus, the quantitative strand was embedded in the form of a pre-interview questionnaire which each interview participant completed a few days prior to the face-to-face interview. It was decided to embed the quantitative strand for the following reasons:

- The questionnaire allowed us to get a sense of the interviewee's project and the role of the scrum master in it. This gave us the freedom to tailor the interview questions to the context of the participant.
- As the face-to-face interviews were time constrained (usually under an hour), considerable time was saved by using the questionnaire to collect demographic and project related information. This allowed us to explore the participant's experience of working more deeply in agile projects.

RESEARCH METHOD

We conducted a Grounded Theory (GT) study, into the role of the scrum master, with a mixed methods approach to employing supplementary quantitative data in addition to the primary qualitative data, within a pragmatic philosophical perspective. This was part of a larger study whose starting point was to study the role of the project manager in agile projects. The other outputs of the larger study (such as the project manager's role) are in different stages of review for publications. This study is primarily qualitative in nature and has used GT as the overarching research method. We have incorporated a mixed methods approach to incorporating supplementary quantitative data as noted by Charmaz (2006).

Mixed methods research has been defined as, "the class of research where the researcher mixes or combines quantitative and qualitative research techniques, methods and approaches, concepts or language in a single study" (Johnson and Onwuegbuzie 2004). In this research, we have used GT to analyze qualitative data and descriptive statistics to analyze quantitative data. As we have further clarified above, there is limited mixing of qualitative and quantitative data, as our study was primarily a GT study, which by its very emergent nature makes pre-determined and systematic mixing of qualitative and quantitative data challenging (Charmaz 2006). The overarching philosophical perspective was pragmatism, most associated with mixed methods usage (Easterbrook et al., 2008).

SCRUM IN SOFTWARE PROJECT MANAGEMENT: A QUALITATIVE AND QUANTITATIVE ANALYSIS"

The purpose of this research is to examine the use of scrum in software project management using a combination of qualitative and quantitative research methods. The title effectively communicates the study's topic and approach, giving readers a clear understanding of the research focus.

DATA COLLECTION

The first step in recruiting participants was to approach practitioners via forums such as LinkedIn and special interest groups such as Agile Auckland. Overall, agile practitioners expressed interest in participating in our research and filled in a pre-interview questionnaire. Due to reasons beyond our control, out of the questionnaire respondents only participants agreed to be interviewed subsequently. Table 1 shows the participant demographics for the qualitative data collection and project information for these participants. Thirty-one of these participants were from New Zealand, six from India, and one each from the USA and Australia. To ensure confidentiality, the

participants have been assigned code numbers beginning with a “P” i.e., P01, P02, etc. If a participant spoke about multiple projects that they were part of, their job titles on each project and the project sector are indicated by the numbers “1” and “2” in superscripts. For example, “Dev1 -AC2” indicates that the participant was referring to a developer role in an earlier project and an agile coach role in a later project. For the project sector, “1” and “2” in superscripts indicate the different sectors of the projects participants spoke about.

Table 1 Participant Demographics

Participant Number	Job Title	Agile Experience in Years	Team Size	Project Sector
P01	Developer	2	11-15	Banking
P02	Project Manager	<1	11-15	Local Government
P03	Project Manager	4	6-10	Telecommunications
P04	Project Manager	4	>25	Local Government
P05	Programme Manager	10	0-5	Insurance
P06	Software Product Manager	3	>25	Banking
P07	Project Manager	5	6-10	Insurance
P08	Project Manager	12	11-15	Telecommunications
P09	Senior Project Manager	5	16-20	Banking
P10	Product Owner	3	6-10	Telecommunications
P11	Program Manager	10	16-20	Finance
P12	Scrum Master	4	>25	Local Government
P13	Developer-Agile Consultant	10	0-5	Accounting ¹⁻²
P14	Agile Consultant	10	6-10	Telecommunications
P15	Developer	4	0-5	Finance
P16	Scrum Master	5	6-10	Utilities
P17	Project Manager & Scrum Master	3	21-25	Accounting
P18	Scrum Master	1	6-10	Finance
P19	Scrum Master	5	6-10	Education
P20	Technology Consultant &	4	11-15	Telecommunications

	(Product Owner)			
P21	Scrum Master & (Agile Consultant)	7	>25	Finance
P22	Developer	6	6-10	Finance
P23	Software Engineer & (Scrum Master)	1	6-10	Taxation
P24	Product Manager & (Product Owner)	5	16-20	Software
P25	Quality Analyst	9	6-10	Education
P26	Scrum Master	6	16-20	Entertainment
P27	Senior Director Product Management	12	6-10	Human Resources
P28	Project Manager-Scrum Master	10	6-10	Retail
P29	SAP Delivery Team Manager & (Scrum Master)	8	21-25	Retail
P30	Solutions Architect	1	16-20	Retail
P31	Program Manager Product Owner	5	6-10	Tourism-Healthcare
P32	Tribe Lead	8	0-5	Healthcare
P33	Scrum Master-Software Engineer	3	6-10	Human Resources-Software
P34	Software Engineer	5	0-5	Healthcare
P35	Senior Test Engineer	9	16-20	Healthcare
P36	Tribe Lead & (Scrum Master)	5	6-10	Healthcare

QUALITATIVE DATA COLLECTION

The qualitative data was gathered from 39 agile practitioners who agreed to participate in an interview after completing their pre-interview questionnaires (summarized in section 3.4.2). As previously stated, the data collection and analysis process were iterative, with each participant completing a pre-interview questionnaire, followed by the face-to-face interview and analysis of a few participants' data before more was collected.

Most of the interviews lasted about an hour and were conducted face-to-face, with the exception of four, which were conducted via Skype because the participants were unable to meet in person. Questions in the interview included: Please tell me briefly about your professional background and current role in this organization; What are the major challenges you have faced while working on the agile project? How did you overcome those obstacles? Part-A of the Appendix contains the complete list of interview questions.

QUANTITATIVE DATA COLLECTION

The pre-interview questionnaire, which was created using Google Forms, was used to collect not only demographic data but also information on agile practices and scrum master involvement in these practices. At least one week before the interview, a link to the questionnaire was emailed to willing practitioners. The pre-interview questionnaire responses were used to tailor the interview questions to the participant's experience and background. Because this was part of a larger study that also looked at other roles in agile (such as project managers and product owners), the survey includes questions that probe the involvement of other roles in various activities. The entire survey questionnaire is now available on Dataverse. (Shastri et al. 2020).

The response options included multiple choice questions such as "Please select the relevant agile methodologies you have used" and Likert scale-type questions such as "Please rate the frequency of using the practices listed below". There was no direct question in the questionnaire which asked respondents if the role of the scrum master was in existence in their project. This information was elicited from participants during the research interview via a more general frame-setting question: "Could you give a brief background of the project and describe your role on the project?" The information given by the participants to this question led to further probing questions about the scrum master's role. The extent of participation and involvement of the scrum master in ten selected agile activities was gathered from the pre-interview questionnaire.

The pre-interview questionnaire generated a total of 47 valid responses. In the initial stages, the survey instrument's focus was on gathering information regarding the presence or absence of the scrum master in the respondent's projects. The analysis of the initial questionnaires and interviews suggested an opportunity to inquire about the involvement of the scrum master in the listed agile practices. Therefore, this was added as a section to the pre-interview questionnaire, later in the research project after around 12 interviews and it was filled out by a total of 35 respondents. These 35 respondents are a sub-set of the overall 47 respondents.

DATA ANALYSIS

In the following sub-sections, we have described the data analysis methodology and techniques applied to the qualitative and quantitative data.

QUALITATIVE DATA ANALYSIS METHOD

Qualitative research is concerned with studying the intangible and social aspects of an environment. These are the aspects that cannot be explored using quantitative methods. While the definition of qualitative methods per se is varied, we have selected Creswell's (2012) definition as it captures the essence of qualitative research: "Qualitative research begins with assumptions and the use of interpretive/theoretical frameworks that inform the study of research problems addressing the meaning individuals or groups ascribe to a social or human problem". There exist different methodologies to analyze qualitative data such as case study, ethnography, and Grounded Theory (GT). For our study we selected GT due to its suitability to generate a theory for software engineering and due to the inductive nature of GT as a key to uncovering the underlying concerns of software engineering practitioners. The lack of a comprehensive theory on this topic made GT a suitable research method for our study.

For analyzing qualitative data, collected via interviews, we have used Glaser's classic GT method. In the following sub-section, we have provided more details of applied GT analysis and a concrete example of the emergence of theory from data.

QUANTITATIVE DATA ANALYSIS

A major part of quantitative data analysis revolved around the data collected from the pre-interview questionnaire. Some of the qualitative data was coded as quantitative data. The first step was to apply consistent labeling to the free-text responses in the pre-interview questionnaire and compare them to the interview transcripts to cross-check for conflicting information. There were only two questions with free text fields: a) "*What sector or domain the project was in?*"; and b) "*What was your job title on the project/product?*" Responses to question a) elicited a range of answers from the survey respondents, sometimes the same project domain was described with different spellings. For example, the project sectors could be described by different respondents as both *finance* and *financial* in the free text response. This was rationalized and a uniform label of *finance* was applied in this case.

FINDINGS OF QUALITATIVE DATA ANALYSIS

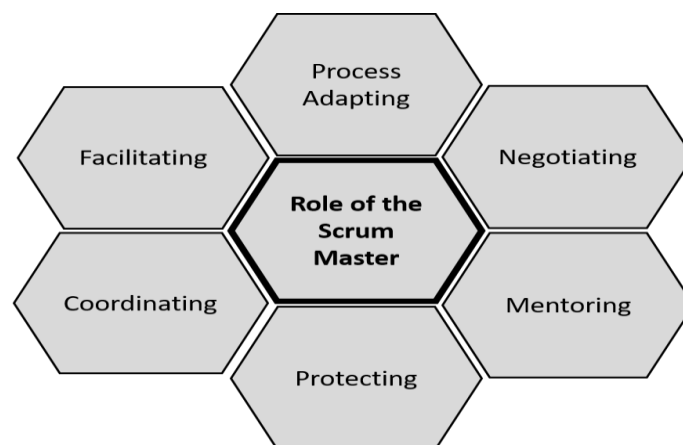


Figure 2: The role of the scrum master in agile projects presented as dimensions.

The theory which emerged from the GT analysis was the “The role of the Scrum Master in agile projects”, in which the role of the scrum master in agile projects is described in terms of the following dimensions, that is, the everyday activities of facilitating, mentoring, negotiating, coordinating, and process adapting, performed by the scrum master. The different dimensions of the scrum master’s role have been visualized in a honeycomb structure and are presented in Figure 2. Each hexagonal cell represents a particular activity (for example, facilitating) and the arrangement of the cells around the central hexagon symbolizes that each activity is a facet of the scrum master’s role.

FINDINGS OF QUANTITATIVE DATA ANALYSIS

When we collected the quantitative data in this section, we discovered that we had a problem with similar responses, which meant that a lot of people were probably answering the questionnaires a lot of the time. Furthermore, the data may not be reliable because individuals were not fully invested or interested and may have answered haphazardly, making the scrum master's job difficult and information unreliable.

IMPLICATIONS OF RESEARCH

Our grounded theory provides a foundation for researchers to build on and generate a deeper understanding of the contexts in which scrum masters function in agile projects. Conducting mixed methods studies to investigate the effectiveness of the scrum master in agile projects is a good direction for future research. The implementation of large-scale agile will be an excellent research setting. We are confident that some of our findings will be applicable to large-scale agile, and that focused research will reveal many previously unseen aspects of the role. Furthermore, our questionnaire is adaptable and can be used with larger sample sizes.

LIMITATION OF RESEARCH

As our GT study utilized qualitative and quantitative strands which had limited mixing, we have presented the limitations separately in the following paragraphs.

A Grounded Theory study produces a "mid-ranged" theory that is limited to the contexts studied but is open to modification based on new data to fit new contexts (Glaser 1992). Participants in our study came from a variety of project sectors, including telecommunications, banking, government, tourism, and retail, and held a variety of roles, including developers, project managers, scrum masters, and test engineers. Based on future research in different contexts, our theory is open to modification and extension.

The quantitative strand's main limitation is the small sample size. Furthermore, while the quantitative study examined the level of involvement and possible association of the scrum master with agile practices, it did not assess the scrum master's effectiveness in those activities. We believe that future research on scrum master effectiveness is warranted. Another limitation is that there may be factors other than the presence of the scrum master that cause certain practices to be used more frequently by the team. Some of the other limitations, such as sampling bias and response bias, have already been discussed in section 6.2.

CONCLUSION

We presented a Grounded Theory study using a mixed methods approach to investigate the role of the scrum master in agile projects in this paper. One of the study's key highlights is the use of qualitative and quantitative data to investigate an intriguing aspect of ASD. We present a grounded theory of the scrum master's role, which explains that scrum masters perform six daily activities: facilitation, mentoring, negotiating, process adaptation, coordination, and protection.

From our quantitative analysis, it appears that there is a positive association between certain agile practices (definition of done, iteration (sprint) planning, project velocity measurement, and short iterations (sprints)) and the presence of the scrum master. These practices exhibited a notable increase in their frequency of use in the presence of a scrum master.

Understanding the role of the scrum master in agile projects will assist practitioners in better managing this role's expectations. The ability to adapt to rapidly changing situations will be the most important factor in ensuring their longevity in organizations transitioning too agile. Scrum masters must be prepared to perform any of the six identified agile project activities.

REFERENCES

- Anderson DJ, Carmichael A (2016) Essential Kanban Condensed. Lean Kanban University Press
- Bass JM (2013) Agile method tailoring in distributed enterprises: product owner teams. IEEE 8th Int. Conf. on Global Software Eng 154-163. <https://doi.org/10.1109/ICGSE.2013.27>
- Beck K, Andres C (2005) Extreme programming explained: embrace change. Addison-Wesley, Boston
- Birks M, Chapman Y, Francis K (2008) Memoing in qualitative research: Probing data and processes. J. of Research in Nursing 13:68-75. <https://doi.org/10.1177/1744987107081254>
- Brewer J, Hunter A (1989) Multimethod research: a synthesis of styles. Sage Publications
- Cockburn A, Highsmith J (2001) Agile software development, the people factor. IEEE Computer 34:131-133. <https://doi.org/10.1109/2.963450>
- Chow T , Cao DB (2008) A survey study of critical success factors in agile software projects. J. of Syst. and Software 81:961-971. <https://doi.org/10.1016/j.jss.2007.08.020>
- Chagas L, Carvalho D. de, Lima A, Reis C (2014) Systematic literature review on the characteristics of agile project management in the context of maturity models. Int. Conf. of Software Process Improvement and Capability Determination 177-189. https://doi.org/10.1007/978-3-319-13036-1_16
- Charmaz K (2006) Constructing grounded theory- A practical guide through qualitative analysis. Sage Publications Ltd, Thousand Oaks
- Creswell JW (2012) Qualitative inquiry and research design: choosing among five approaches. Sage Publications Ltd, Los Angeles
- Creswell JW, Plano Clark VL (2011) Designing and conducting mixed methods research. Sage Publications Ltd, Los Angeles
- Deemer GBP, Larman C, Vodde B (2012). The Scrum Primer. <http://scrumprimer.org/>. Accessed 20 November 2018.
- Denzin NK, Lincoln YS (2017). The SAGE Handbook of Qualitative Research. SAGE Publications
- Fowler M, Highsmith J (2001) The agile manifesto. Software Develop. Magazine 9: 29-30.
- Glaser BG (1992) Basics of grounded theory analysis. Sociology Press, Mill Valley
- Glaser BG, Holton J (2004) Remodeling grounded theory. Forum: Qualitative Social Research, 5:47-68. <http://dx.doi.org/10.17169/fqs-5.2.607>
- Glaser BG, Strauss AL (1967) The discovery of grounded theory: strategies for qualitative research. Aldine, New Brunswick

Glaser BG (1978) Theoretical sensitivity: advances in the methodology of grounded theory. Sociology Press, Mill Valley

Hoda R, Noble J (2017) Becoming agile: a grounded theory of agile transitions in practice. Proc. of the 39th Int. Conf. on Software Eng 141-151. <https://doi.org/10.1109/ICSE.2017.21>