"How to Successfully Apply the Agile Software Development Methodology in a Strongly Scientific Development Culture Using the Scrum Framework?"

Scrumara - J.H.J.Zwart, MA, MSc

TABLES AND FIGURES

ABBREVIATIONS

STRONGLY SCIENTIFIC SOFTWARE DEVELOPMENT CULTURE: ..... SSSDC
AGILE SOFTWARE DEVELOPMENT METHODOLOGY ..... ASDM
SCRUM FRAMEWORK..... SF
SCRUM PROCESS..... SP
SCRUM AWARENESS..... SA
SCRUM DELIVERABLES..... SD
AGILEPRINCIPLES..... AP
AGILE MANIFESTO.....AM
AGILE FRAMEWORK.....AF

Declaration of originality

I, Jaap Zwart, declare that I am the sole author of this dissertation, and that the work is a result of my own investigations, except where otherwise stated. All references have been duly cited.

Abstract

Commercial successful software products that address a specific scientific domain usually started out as an exploratory prototype written by group of subject matter experts with strong scientific background who have acquired the programming skills, transforming their theoretical formulas into working code. Research and planning typically do not marry well. Particularly, the traditional waterfall approach with its strong focus on a predefined requirements scope, design and implementation phase, does not appeal to research staff who find it difficult to predict what they are going to build.

The aim of this research was to analyze how the Agile Software Development Methodology (ASDM) using the Scrum Framework (SF) and proper use of the scrum deliverables (SD) could be successfully implemented within a strongly scientific software development culture (SSSDC). Through semi structured interviews (SSI) and non-participant observations (NPO) several SSSD teams were analyzed with different levels of scrum experience on their use of the SD and its related influence on the success of the ASDM implementation using the SF.

This research showed that the lean ASDM approach seems to be a better fit for research developers working on scientific software solutions for it embraces change. It was obvious that the iterative and incremental lifecycle approach that Agile supports, proved to be much better tailored to the research way of development in that it allowed for timely changing direction if an idea does not yield the expected result or users provide different requirements. The same benefits applied when using research stories which are often difficult to manage.

The final conclusion of this study is that properly refined iterations with well-defined user stories and small transparent tasks seemed to automatically lead to an increased chance of successful implementation of the ASDM using the SF within the SSSDC of the company being analyzed. Proper use of the SD was essential to increase the quality of the ingredients of this success.

1 Introduction

This study will seek to clarify how the Agile Software Development Methodology (ASDM) can be successfully implemented in a Strongly Scientific Software Development Culture (SSSDC). The secondary aim will be to formulate some guidelines on dividing research oriented tasks into smaller units of work for transparency and increased project control. Momentarily many software development projects in a SSSDC seem to have a negative attitude about the usefulness of implementing and applying the ASDM (Sletholt, et al., 2011). Companies or project managers find it very difficult to define the proper level of user stories and tasks for scientific research related requirements.

It is the assumption of this research, based on experience and literature, that the ASDM can be useful within a SSSDC when the right transparency and detail level of user stories and related tasks are used for research related work (Hicks & Foster, 2010). A broader and more fundamental assumption of this research is that the SD as defined in Appendix G- Scrum Deliverables can be very useful for increasing this transparency and detail for user stories and tasks.

The research question that shaped and guided the design and execution of this study is thus formulated as follows:

> *How can the ASDM be successfully applied in a strongly scientific dominated software development culture with large degrees of uncertainty and a lot of exploratory prototyping required?*

The research objectives are to:

1. Critically review theories and possible evidence on how the agile development methodology can be successfully applied within a strongly scientific development culture.
2. Evaluate how the agile development methodology can positively influence the transparency of research user stories or work items within a strongly scientific development culture.
3. After evaluation recommend how the agile development methodology can improve the work within scientific development cultures.

The focus of this study is a multinational organization operating within the oil & gas industry. Many SSSD projects are executed within this company related to studies around drilling locations. Although the interviews and observations are done in the Netherlands, the teams are in large parts, multi-national. Members operate internationally with teams around the globe. The focus of this study is therefore on internationally oriented SSSD teams and projects, while the interviews and observations are executed in the Netherlands.

This study investigates how the ASDM can be successfully applied within a SSSDC, using the SF and making use of the SD. Therefore, members of Scrum Team(s) (ST) were chosen as participants for the SSI and NPO. In every team the Scrum Master and Product Owner were participants, combined with regular ST members. Because the SF is an international standard, it was essential to analyze how the SSSD scrum team members of different nationalities behaved towards the SD and the Scrum Process Inputs, Behavior and Outputs.

Because the chosen multinational company operates in many countries and diverse cultures with differentiated SSSD projects, the consolidated answers and outcomes of the research objectives will likely also be of use for other internationally operating organizations with SSSD projects while trying to implement the ASDM using the SF. This international orientation is reflected in the literature review where used sources have a broad focus related to the research objectives. The literature review was intentionally executed as such specifically because the organization being studied had this cultural divers and heterogeneous use of SSSD projects.

1.1 Relevancy of the Study

A SSSD research project is often build upon traditional software methodologies and project management. The characteristics of these traditional managed projects are a lack of insight in the ever-changing work that needs to be done (Gibbs, 2006). Such projects often do not finish within time, budget, and in many cases, do not deliver what the

customer expects. The traditional project management approach is not very adaptable to change, which is a main characteristic of research projects where outcomes are often fluid in nature (Charvat, 2003; Turner, 2009). These difficulties and the search for the right use of the ASDM within a SSSDC, was the motivation for this study to research the expected positive influence of an ASDM on the transparency and efficiency of the development work within the SSSDC being analyzed.

Semi-structured interviews - combined with the nonparticipant observations – are carried out to investigate the relevance of these outcomes within a real-life situation where the ASDM is being introduced, applied and used within a SSSDC. The results of this study can be used during future transitions within SSSDC's from traditional managed software development towards a more ASDM.

1.2 Chosen Methodology

This study is based on qualitative methods, a technique that is considered especially useful when the context of research is not well understood and when the perspectives of participants are of interest. The applicability of qualitative research increases when the deciders, implementers and users of the process are also part of the study-focus; which is the case in this research (Doueck, 2010). The Grounded Theory (GT) method developed by Glaser and Strauss (1967) was chosen as the qualitative technique for this research. This method will guide the study with data collection, categorization, interpretation and generalization into some basic assumptions. From these basic assumptions, the Axial coding categories will cumulate in a central category as the basic result of this study. The GT methodology was chosen because most relevant literature reflecting the possible positive influence of the ASDM within scientific research development environments, also use some sort of qualitative research. This focus on qualitative research also guided the literature review being used in this study. To be able to create a new theory and hypothesis, the choice for the GT methodology seemed therefore appropriate, justified and applicable.

The main data of this study was collected and categorized according to the GT method as described by Glaser and Strauss (1967) and Mulatiningsih (2015) reflected in figure 1.1 – GT data analysis Process. The work of Tjitra (2011) is used to relate the diagram of Mulatiningsih (2015) with the coding principles of the GT.

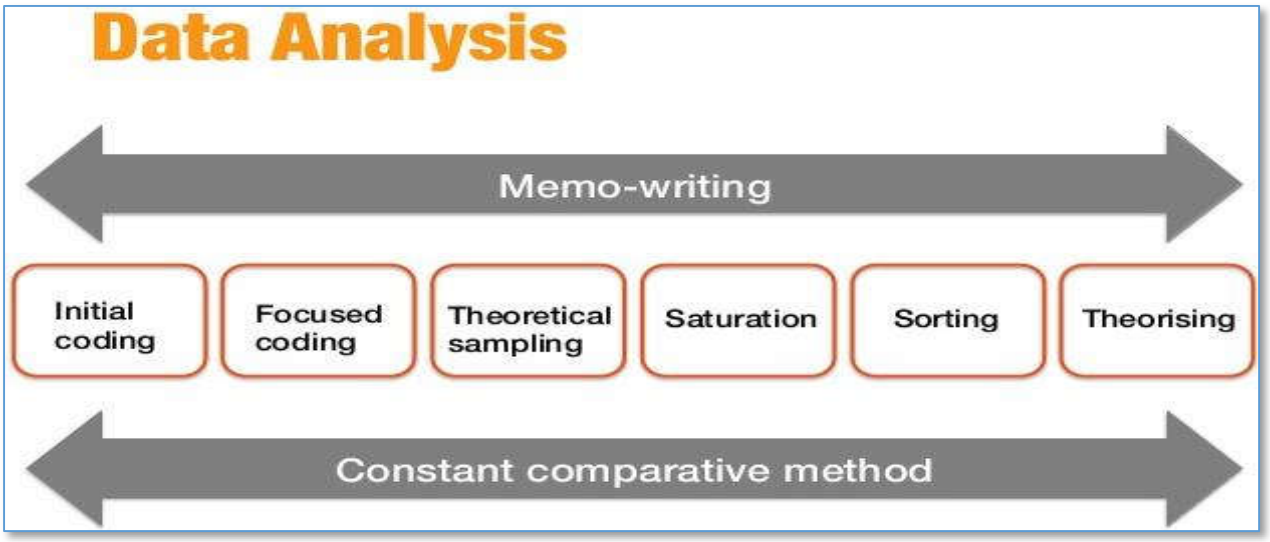

Figure 1.2.1: Grounded Theory Data Analysis Process (Bekti Mulatiningsih, 2015)

1.3 Topics of investigation

The focus of this study was based on the table of Scrum Inputs, Behavior and Outputs, which can be found in Appendix A - table 8.1 - Inputs, tools/behavior and outputs of the Scrum Framework. While the agile development principles do have a very broad focus, this study narrows it down by using Scrum as the preferred agile framework, to successfully implement the ASDM within a SSSDC. As can be seen in Appendix A - table 8.1 the topics are divided in two parts. There are 6 main elements for the Inputs, Behavior and Output, of which will be integrated in the qualitative research. The topics beneath the line will be used as sub-questions and observations. This can broaden and intensify the context of the interviews and eventually enrich the data presentation.

The literature review will reflect how the elements of this table could result in a successfully implemented ASDM using Scrum within a SSSDC. The SD are integrated in the 6 main elements of the Input, Behavior and Output segments. The teams being

investigated answers questions related to this table and the answers will tell something about their perception and use of these Scrum Inputs, Behavior and Outputs.

1.4 Overview of the chapters

This dissertation will consist of the following chapters and content.

- Chapter 1: Creates a context for the research.
- Chapter 2: Provides the theoretical critique of existing bodies of work in the field and further context for the proposed research.
- Chapter 3: Outlines and justifies adopted methodology and research design.
- Chapter 4: This chapter presents the main outcomes from the analysis of the gathered qualitative data. The analysis will employ the use of consolidated data and graphs, along with associated discussions of the key results.
- Chapter 5: The final chapter will outline the main study conclusions as well as the main limitations, personal reflection, and recommendations for further research.

2 Literature Review

This chapter will provide a critique of existing bodies of work towards analyzing if and how the ASDM can be successfully used within a SSSDC. The literature review is divided into four parts (1) Project Management, (2) The ASDM, (3) The Scrum Framework (SF) and (4) ASDM with the Scrum Framework in a SSSDC. Several other abbreviations will be used throughout the text being: Scrum Deliverables (SD), Agile Principles (AP), Scrum Artifacts (SA), Scrum Process (SP), Agile Manifesto (AM), Agile Framework (AF) and Strongly Scientific Software Development (SSSD) with often an extra addition like Teams, Environment or others.

2.1 Project Management

Project Management is concerned with guiding and planning many tasks and activities which are often temporary in nature (Turner, 2009; Maylor, 2010). Compared to the literature on leadership, Project Management remains a relatively new discipline (Morris, 1994), where its main focus is rational in nature. It is mainly based upon the iron triangle cost, time and quality, where customer satisfaction was added later (Bryde, 2005). Although project management is a relatively old phenomenon, it was not called as such until the 1950s. The concept of collaborating to achieve a certain goal, on the other hand, is as old as written history (Kozak-Holland, 2011). The foundation of project management was laid in the early 1900s by Henri Fayol (1841-1925) and Henry Gantt (1861-1919) when they defined five important management functions which cumulated in the primary project management roles planning, organizing, commanding, coordinating and controlling (Chiu, 2010).

After setting the stage of the context of project management by Frederick Winslow Taylor (1856-1915), Fayol (1841-1925) and Gantt (1861-1919), among others, the planning and scheduling game entered the construction projects and factories. The well-known Gantt charts were used to do the planning and often decorated the walls of many self-respecting manager and organization (Lock, 2004). Almost parallel in Britain, Belgium, and the US, the critical path methods were developed in the 1950s. Interestingly this critical path