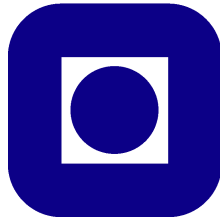


Research Methodology in Computer and Information Science

N T N U



Morten Bujordet

Norwegian University of Science and Technology

Plan for research studies

My research is divided into two phases, a research project in the fall and master thesis in the following spring. This research plan will cover both phases.

Purpose

The Construction Industry (CI) has been a significant part of engineering throughout history. Over the past century, the requirements of constructions have become more and more complex [6]. The buildings are getting higher, the tunnels are getting longer, and the roads are getting wider. Sure, the size of things is not equal to the complexity of the construction; however, when considering automated systems, multipurpose functionality, and multiple communication platforms – the complexity is increasing. The increased complexity leads to a significant decline in labor productivity (LP), seen over the past two centuries, mentioned in the article written by SSB [5]. As well, managing these projects is much more intricate than it used to, because of the increased numbers of actors participating in the project.

The challenges the CI is experiencing, as well as the process used, are highly similar to what the ICT-industry was facing in the late '80s. The ICT-industry, using the waterfall process [4], often faced the challenge of meeting the budgets and timelines. This breach had the origin in change of requirements during production, challenges in testing, and resultingly failing to deliver a finished product without bugs [1]. These problems have been frequently present when creating large and highly user-interactive software — making for the introduction of agile software development to manage these problems. Over the years, most of the process- and method-management in ICT is digitized. Giving tools in which both the software developers and project managers use to aid project progression.

Frank Garry, in 1997, first introduced 3-D modeling in CI, when constructing the Peter B. Lewis Building. 3-D modeling was used both to manage the complexity of the installation, but also led to increased cooperation between different parties within the project. The paper[2], describing this project, is reporting a change in how actors in the construction react to using computer-aided constructions, in 3-D. Today 3-D modeling is used in almost all construction projects and is known as BiM. Even though this project showed promising results in means of cooperation and interaction, the introduction of 3-D modeling and BiM was not a single solution to the problem.

Furthermore, one has introduced Lean in the CI. The book [3] describes the making of the Bergen Academy of Art and Design-building, where Lean was one of the essential strategies. The object of the Case Study in this research are using experience from this book when managing the constructions.

The motivation for this research is to examine a project utilizing Lean in project management, to face the problems mentioned. Furthermore, looking at how a project make use of digital tools, aiding Lean has not been examined before. Taking experience from the ICT-industry, and the use of computer-aided agile development management is also desirable, as well as looking at the problem from a different perspective.

This project, therefore, aims to examine the fundamental reason for the striking difference in labor productivity between the ICT-industry and construction industry. The intention is not to measure productivity, but rather understand why the difference occurs.

RQ1: Why does the difference in LP between the ICT-industry and CI appear?

RQ2: How does the difference appear in the case object, which utilize both agile and digital tools?

Contributions

The main contribution of the study is improved knowledge and theory of the of the fundamental reason for the striking gap in LP, between the CI and ICT. The project thesis has two valuable contributions: (1) the literature review; and (2) guidance as to where to target the research in the master thesis. The master thesis will consist of data collection and the analysis of the data, using a theme analysis, where the result of the analysis adds to the main contribution.

There is little to none studies of this particular problem, but will contribute to the knowledge in implementation and use of software in complex organizations. The use and implementation of new software are considered a significant field of study in computer science, but using this knowledge in the CI will, consequently, give insights they never have and rigorously wants, given the will for digitalization; hence, this study is desirable.

Research Method

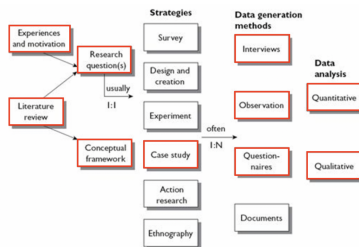


Figure 1: The research process used, marked with methods applied in the research.

This project originated in the interest in Software methodology, and how software aids productivity and cooperation in different parts of society. The projects formed when Patrick Stormo Hjerpseth, who is the Project Lead in Digitalization at the case object, gave a tip regarding writing a master thesis about object.

The project started with a literature review, providing a conceptual framework for the project. Based on the literature review, one could see a clear correlation between software engineering (SE) 30 years ago and the construction engineering (CE) of today.

To identify how these problems can be faced in a project, using agile management methods and CSCW, the master thesis is planning a case study-strategy. The case studied is the the Life Science Building construction project.

First, the research will do a minor empirical study in the project thesis, utilizing observation and interviews as data generators. This research will hopefully give insights that will bring the research to a narrower focus on the following master thesis.

Secondary, in the master thesis, conduction of interviews and a questionnaire will aid the analysis as data generation methods. If necessary, observations will be conducted. The questionnaire will give questions on a standardized format that can be valuable in the analyses. Furthermore, the interviews will help to discover matters not covered in the questionnaire. Both interviews, the questionnaires, and observations will give quantitative data for the analysis.

Participants

The project researcher, Morten Bujordet, is involved in the project, creating the plans, and conducting the research.

Supervising the project is Eric Monteiro. Eric is contributing with experience in research in the implementation and use of new digital tools in large scale organizations.

Furthermore, Statsbygg, as the construction manager, has an interest in the project: giving access to the participants in the study. With Patrick Stormo Hjerpseth as the point of contact.

In the research, the actors using the digital software in the project design will be an aim for the

data collection. All personal information gathered will, safely, be stored in a GDPR-compliant Cloud Service, served by NTNU. In the final report, no personal information will be published, and all actors in the data collection will be anonymized.

Research Paradigm

The research strategy is adopting a case study-strategy, of a single case object. Data is generated using several methods: interviews, observation, and a questionnaire. This study is related to the interpretive paradigm — the thorough use of empirical observation of the participants and a desire to identify how they act on the new software used. Using interviews can lead to being subjective as all collection of data is done in interaction with the participants. This yields a qualitative collection of data. On the other hand, the survey is considered objective, with no interactions, giving a quantitative data collection, based on facts. Using both will, in the end, yield an objective study.

Final Deliverables and Dissemination

The final deliverables of the project are three documents: (1) project thesis, (2) master thesis, and (3) a 5-7 pages report given to Statsbygg, containing the most significant findings in the research.

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