Designing a Management Information System to Support Business School Accreditation Status

University of Oulu
Oulu Advanced Research on Service and Information Systems
Master’s Thesis
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Abstract

Oulu Business School required a management information system which would reduce the manual work requirements for AACSB reports and improve the overall data collection process. By employing design science research, it was possible to construct a detailed analysis of the requirements of Oulu Business School and model these into a set of objectives for the system. These requirements were extrapolated further, using Agile methodology, into a concise list of user stories which would form the backbone of the development process. To meet the needs of both the faculty and AACSB accreditation, Oulu Business School wanted to replace their current data collection process with a web-based information system. This system that would collect contribution information from all staff members and generate a variety of reports from the data collected on-demand.

Although there was a pre-existing system, it was not considered fit for purpose. Therefore, the project started from nothing. This allowed the team to gather concise requirements as well as using previously unused methodologies. To this end, we focused on using Design Science Research as this the study of how an information system behaves dependent on its overall purpose. In the main, the motivation for this research was the need to improve its data collection and information processing methods of the Oulu Business School.

By employing a combination of Agile development methodologies and design science methodologies, it was possible to build a very clear concept of what was to be developed and how. Design science provided the foundational knowledge required to define the nature of the system while Agile provided the tools for creating the artefact in an efficient and effective manner.

The artefact was created over a 5-month development period with 10 sprints, or iterations, in total. Overall, the project managed to achieve the majority of the goals that were set and produced a fully-fledged system which has entered full use by the Oulu Business School. Additionally, the success of the system has been such that Oulu Business School has continued developing OBSIC and is considering the possibility of offering the system to other accredited schools.

Keywords
management information systems, design science research, scrum development, agile, information systems

Supervisor
Dr. Piiastiina Tikka
Foreword

I would like to take this opportunity to express my deepest gratitude to the staff of the Oulu Business School for their help throughout the creation of the OBSIC system. In particular, I would like to say a massive thank you to both Pasi Karjalainen and Jaakko Simonen for their support and encouragement throughout this project.

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Finally, I would like to thank my friends and my family. Your belief in me made me believe in myself. Thank you.
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1. Introduction

Since its foundation in 1958, the Oulu Business School has provided students of the University of Oulu with high quality education in a wide variety of business related fields. As of 2016, Oulu Business School supports a faculty of 100 staff and researchers and has approximately 1600 students enrolling annually. As part of its ongoing mission, Oulu Business School sought accreditation from the Association to Advance Collegiate Schools of Business (AACSB), an internationally recognised accreditation board for business schools. For the managerial staff of Oulu Business School, this is among the most significant achievements in the history of the school, as only 5% of the world's business schools have fulfilled the AACSB accreditation standards. Closer to home, Oulu Business School is now one of only four AACSB accredited business schools in the Nordic region.

According the AACSB’s own literature, it is the world’s largest non-profit business education network. Primarily, AACSB aims to connect students, educators, and businesses to advance and improve worldwide business education. Since its establishment in 1916, AACSB has become a global association of over 1500 members spanning 90 countries. Currently, there are more than 760 business schools accredited worldwide, AACSB ensures the highest quality standard in business education to prepare the next generation of business leaders. (Association to Advance Collegiate Schools of Business, 2016)

To obtain AACSB accreditation, the Oulu Business School was evaluated according to 21 standards (Association to Advance Collegiate Schools of Business, 2016). These focus on different aspects of the normal operation of the school and cover areas such as strategic management, the quality of the school's faculty, and the level of education programmes and student learning. To maintain its accredited status, Oulu Business School is audited every five years. During this audit, Oulu Business School must provide a variety of information concerning the operation of the school. Along with information regarding educational opportunities offered, information concerning the intellectual contributions of faculty members must also be produced. These contributions cover a range of faculty endeavours such as published papers for international peer reviewed journals or the development of new courses. This information must be produced on a yearly and five-yearly basis and must show the contribution of the entire Oulu Business School faculty, the respective departments of the faculty, and every contributing member of the faculty staff.

At the beginning of 2014, Oulu Business School commissioned a project to overhaul the data collection methods for the intellectual contributions of faculty members. Primarily, this project was intended to remove the use of spreadsheets and word documents for data collection and to improve overall data collection and information processing. To achieve this, Oulu Business School desired a web based platform where users could securely log in and record information regarding themselves and their intellectual contributions. The aim was to remove the need for individual user to maintain their own spreadsheet while also eliminating the need for the Oulu Business School AACSB accreditation team to collate the data manually. Additionally, this system was to provide the means of collating this data into reports suitable for supporting the accreditation process.

Unfortunately, the outcome of the 2014 project did not meet the requirements of Oulu Business School. While the produced system provided partial functionality, changes in the requirements of AACSB rendered parts of the system obsolete. In response, Oulu
Business School added a second phase onto the project to allow the new system to be further enhanced. At the end of the project’s second phase, the system was considered a viable proof of concept. However, the system still lacked key functionality and decisions made during the first phase of the project had negatively impacted the capabilities of the system. Consequently, Oulu Business School decided to fund a six-month project to fully develop the system. On review, the structure of the system from the previous project was deemed unfit for purpose. Many of the component modules were no longer used and much of the reporting functionality was not present or poorly implemented. As such, it was decided that the third phase of the project would effectively rebuild the system.

At the beginning of this third phase, the information collection process for AACSB accreditation was still achieved using word documents and spreadsheets. While this collection was ostensibly an ongoing process, the accreditation information was only collected once per year. The accreditation team were unhappy with this as it meant that it was very difficult to assess the current state of the faculty. Additionally, the collation of the information collected into meaningful reports was a substantial drain on the resources of the accreditation team. Minor changes to reports, missing or incorrect data, or changes to the reporting period created significant problems or required additional work.

To address this, Oulu Business School wanted a web-based information system, referred to as the Oulu Business School Intellectual Contribution System (OBSIC). Oulu Business School envisioned this as an information system that would collect contribution information from all staff members and generate a variety of reports from the data collected on-demand. Additionally, Oulu Business School wanted to divide the user base between Users and Super Users. While both user groups would have access to the contribution collection system, only Super Users would have access to the reporting and administration tools.

The advantage offered by starting the project from a zero point was that the project team could gather concise requirements. Additionally, the team could employ previously unused methodologies to overcome some of the problems faced by the previous project e.g. poor planning, ill-defined purpose, and design inflexibility. To this end, we focused on using Design Science Research. It was felt that design science research would allow the study of how an information system behaves dependent on its overall purpose. This would allow us to study the way in which an information systems are constructed and the factors which influence this process. In this instance, we are concerned with an information system tailored to meet the needs of the Oulu Business School. As such, this thesis describes the design and development process for an information system that will aid the Oulu Business School with their ongoing operations. Oulu Business School’s need to improve the overall data collection and information processing is the main motivation for this project. This is to ensure that they can provide the necessary information to retain ASSCB accreditation.

Central to this is the question of how to create a software artefact that meets the expectations of the Oulu Business School in an effective and resource efficient manner. While Design Science Research offers guidance and a framework towards this, it does not provide a full set of methodologies for product development. As such, this research will employ Agile development methodologies. Primarily, the aim will be to consider:

- In what areas do design science research and Agile methodologies overlap?
- What are the notable advantages of combining these methodologies?
It should be noted that there was only one person developing this system. As such, some Agile methodologies e.g. Pair Programming were not considered for use. Instead, scrum methodologies were adopted as these were the easily adapted for small team software development while also offering significant areas of overlap with design science research.

The remainder of this thesis is divided into seven chapters. Chapter 2 will consider the existing research on information systems and chapter 3 will offer an overview of the methodologies used in this thesis. Chapter 4 will focus on the design process, Chapter 5 will explore the system itself and Chapter 6 will detail the evaluation of the system. Finally, chapter 7 will discuss the thesis and its findings and chapter 8 will offer the conclusions.
2. Prior Research

This chapter offers an overview of the prior research concerning information systems and their classification. The core motivation for the research along with the results of a literature review are presented, explaining how existing terminology influenced the development of the OBSIC system.

2.1 Motivation

The main motivation for this research was the need to improve data collection and information processing methods of the Oulu Business School. The current system of spreadsheets and word processing documents had become increasingly cumbersome and significant problems had emerged. Neither the accreditation team nor the faculty management were satisfied with this, especially with the lack of easily repeatable report generation and the time required to collect and collate faculty information. Additionally, the faculty management desired a more expansive report system that could be adapted and changed to meet the needs of both Oulu Business School and the AACSB accreditation in the future.

Prior to the launch of this project, other software solutions had been considered for use by the Oulu Business School. The aim was to find a software package that would meet the requirements of Oulu Business School and AACSB with regards to data collection and reporting. Through discussions with other accredited business schools and their own exploratory research two options were given consideration; SAP and Sedona. SAP offers a wide variety of Enterprise Resource Planning systems, covering a wide array of industries. Although other business schools had successfully used SAP as a means of controlling the accreditation process, Oulu Business School decided not to take it into use. Primarily, SAP was viewed as too complex, too expensive, and too difficult to deploy and customise.

According to their own documentation, Sedona offers a system specifically designed to assist schools with accreditation (Sedona Systems, 2017). Sedona is primarily focused on the gathering of information for the accreditation process, however it offers other features including statistical analysis of student hours and faculty member workload summaries (Sedona Systems, 2017). However, there were several concerns raised with regards to Sedona. Again, concerns regarding the immediate and ongoing costs of the software were raised. Additionally, the managerial team were concerned over the possibility of customising the software. Either this would prove impossible, resulting in a software that did not meet the needs of Oulu Business School, or that it would incur significant extra expense. Finally, the hands-on experience of the accreditation team did not produce positive feedback with many feeling that the system would not fit their needs or the needs of Oulu Business School.

Since neither SAP or Sedona were considered suitable, Oulu Business School decided to fully develop a custom system. While there was moderate success with the initial projects, the earliest iterations were viewed as viable proof of concept due to a lack of certain key features. Starting from a zero point with the development not only allowed the summation of problems faced by the earlier development, it also enabled the development of a clear vision regarding what the new system should be capable of.
2.2 Research Process

As part of this research, consideration was given to what type of system was to be developed. While the umbrella term of information system would have been acceptable, the domain of information systems is so vast that conflicting expectations could arise from differing opinions. Beyond offering a clearer concept regarding what was being developed, defining the specific type of system would also improve communication to external organisations.

However, this thesis is primarily focused on the development of an information system. As such, the aim was not to provide an exhaustive review of the current literature. Instead, a rapid review was conducted. Using the guidelines recommended by Booth, Papaioannou, & Sutton (2012), the aim was to assess what is already know about information systems while seeking a clear definition regarding the type that would be of most use to the Oulu Business School.

2.3 Information System Types

At a fundamental level, information systems are a combination of hardware and software components for the collection, processing, and distribution of information (Laudon & Laudon, 2014, p. 45; Valacich & Scheider, 2011, p. 21). However, the field of information systems is diverse. With the ubiquitous nature of information technology and the explosion of internet related activities, from e-commerce to data mining, there are few facets of the business world that does not employ some sort of information system. Consequently, there are a wide variety of information systems, all designed to fulfil a well-defined purpose. A selection of information systems is presented below.

<table>
<thead>
<tr>
<th>Type of System</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application Transaction processing system</td>
<td>Process day-to-day business event data at the operational level of the organization</td>
</tr>
<tr>
<td>Management information system</td>
<td>Produce detailed information to help manage a firm or a part of the firm</td>
</tr>
<tr>
<td>Decision support system</td>
<td>Provide analysis tools to support quantitative decision making</td>
</tr>
<tr>
<td>Intelligent system</td>
<td>Emulate or enhance human capabilities</td>
</tr>
<tr>
<td>Data mining and visualization system</td>
<td>Systems for analysing data warehouses</td>
</tr>
<tr>
<td>Enterprise resource planning system</td>
<td>Support and integrate all facets of the business operations and human resource management</td>
</tr>
<tr>
<td>Knowledge management system</td>
<td>Collection of technology-based tools to enable the generation, storage, sharing, and management of knowledge assets</td>
</tr>
</tbody>
</table>

Table 1 Information Systems adapted from Valacich & Scheider, 2011.
From the general definitions of information systems, it was concluded that only management information systems and decision support systems appeared to offer the appropriate characteristic to match the needs of the Oulu Business School. As such, it was necessary to compare the characteristics for each of these in order to determine the most suitable option.

Management information systems are generally defined as a system that provide information which supports managerial processes and activities (Al-Shargabi & Sabri, 2015). This can range from supporting the managerial staff of an entire organisation down to the activities of single subunits (Asemi, Safari, & Zavareh, 2011) by meeting the needs of management when information is required (Duffy & Gartner, 1969). In general, management information systems tend to focus on internal data, produce fixed and standard reports, and produce both scheduled and on-demand reports (Asemi, Safari, & Zavareh, 2011).

Conversely, decision support systems tend to be focus more on the so-called wicked problems which tell to be poorly defined and semi-structured (Pretorius, 2016). Unlike management information systems, decision support systems tend to be designed for use by a single managerial group and tend to be very specialised (Asemi, Safari, & Zavareh, 2011). These systems tend toward what-if analysis of a variety of data, both internal and external (Valacich & Scheider, 2011, p. 256). Additionally, these systems are designed to handle large volumes of data in order to offer a heuristic problem solving approach.

When considering the needs of the Oulu Business School, it became clear that the best approach would be to develop a management information system. Overall, a decision support system would provide an overly complex solution with a number of unneeded features. A management information system, on the other hand, should provide sufficient coverage and capabilities to meet the needs of the Oulu Business School.
3. Methodology

This chapter is divided into two sections. The first section outlines the fundamental principles of Design Science Research with regards to information systems. Additionally, Design Science Research Methodologies are explained as well as the models and guidelines set forth. The second section will cover the principles of Agile software development alongside an outline of the main actors and methods of scrum.

3.1 Design Science Research

Within many organisations, information technology is used as a means of increasing organisational productivity, efficiency, and effectiveness. Often, IT artefacts are used to enhance the problem-solving capabilities of users by providing both intellectual tools and computational power (Hevner A. R., March, Park, & Ram, 2004). Indeed, the changes to the business landscape through increased globalisation and the shift toward knowledge-based economies has led some to argue that some companies cannot survive without information systems while others simply would not exist (Laudon & Laudon, 2014, p. 42). However, it can be challenging to design information systems effectively and efficiently. Consequently, a great deal of literature has been devoted to methodologies, such as design science research, aimed at improving our understanding of the creation process of IT artefacts.

Before exploring design science research, it is necessary to offer a clear definition of IT artefact as used throughout this research. It has been argued that design science research seeks to create artefacts that encapsulates the ideas, practises, and products required to design and implement information systems. Hevner and March (2003) offered four distinct categories for IT artefacts; constructs, models, methods, and instantiations.

<table>
<thead>
<tr>
<th>Artefact Type</th>
<th>Provides</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constructs</td>
<td>Language for defining and communicating problems and solutions</td>
</tr>
<tr>
<td>Models</td>
<td>Constructs to represent real world situations, problems, and solutions</td>
</tr>
<tr>
<td>Methods</td>
<td>Definitions of solutions processes</td>
</tr>
<tr>
<td>Instantiations</td>
<td>Examples of constructs, models, or methods applied to a working system</td>
</tr>
</tbody>
</table>

Table 2 Types of IT artefacts adapted from Hevner & March, 2003.

Hevner et al. present Design Science as a counter point to the research cycle for Information Systems. They argue that the aim of Design Science is to offer the means of creating and evaluating IT artefacts in response to an identified organisational need. To achieve this, Hevner et al. proposed that a build and evaluate loop be used to improve the quality of the final artefact as well as to increase the overall understanding of the problem at hand. Indeed, they state that the design process should be a sequence of expert activities
with the intended outcome of producing an innovative artefact. (Hevner, March, Park, & Ram, 2004)

To help define the domain area of Design Science, Hevner et al. (2004) proposed a conceptual framework (Figure 1). As can be seen, information system research is influenced by both the knowledge base and the environment. This environment is a combination of the people, organisation, and technology within which exists a variety of goals, tasks, problems, and opportunities. Collectively these create business needs which provide relevance through an applicable problem domain for the IS research. (Hevner A. R., March, Park, & Ram, 2004)

The knowledge base provides the raw material required for IS research. Prior research provides foundation knowledge used to develop theories and artefacts. Additionally, pre-existing methodologies are used to as a means of justifying the research as well as providing tools for evaluation. By employing the foundations and methodologies ensures the overall rigor of the IS research through offering viable means for research replication by other researchers. (Hevner A. R., March, Park, & Ram, 2004)

In addition to the proposed framework, Hevner et al. (2004) also offered seven guidelines for design science research with regards to IS research (figure 2). In brief, they argued that any artefact created through design science research should have a clear purpose and innovative design focused on a specific problem domain. The utility of any artefact should be demonstrable through thorough evaluation. Additionally, the artefact itself should be rigorously defined to show the contributions to the existing knowledge base. This also extends to the design process, showing how the problem space was defined and constructed while also demonstrating how existing knowledge was utilized with regards
to the problem domain. Finally, the research must be communicated as to be appreciated by a variety of audiences.

1. Design as an Artefact: Design-science research must produce a viable artefact in the form of a construct, a model, a method, or an instantiation.

2. Problem Relevance: The objective of design-science research is to develop technology-based solutions to important and relevant business problems.

3. Design Evaluation: The utility, quality, and efficacy of a design artefact must be rigorously demonstrated via well-executed evaluation methods.

4. Research Contributions: Effective design-science research must provide clear and verifiable contributions in the areas of the design artefact, design foundations, and/or design methodologies.

5. Research Rigor Design-science: research relies upon the application of rigorous methods in both the construction and evaluation of the design artefact.

6. Design as a Search Process: The search for an effective artefact requires utilizing available means to reach desired ends while satisfying laws in the problem environment.

7. Communication of Research: Design-science research must be presented effectively both to technology-oriented as well as management-oriented audiences.

Figure 2 Guidelines for Design Science in Information Systems Research adapted from Hevner et al. (2004).

However, while Hevner et al. presented these guidelines they also advised against mere rote application. Instead, it was suggested that while the guidelines should be addressed in some manner by design science research, the overall application of the guidelines is more often defined by the specifics of a project. It was offered that only the researcher and their audience could decide how well the research matched the intent of the guidelines. (Hevner A. R., March, Park, & Ram, 2004)

Hevner further expanded on his earlier work by suggesting a three-cycle process for Design Science Research. Expanding from the original frame work (Figure 1), three additional interconnected research cycles were identified; Relevance, Design, and Rigor (figure 3). These cycles represented the way in which progressing research was both influenced by and influenced the environment and knowledgebase. The aim here was to show that the design science research was an iterative process which was continually influenced by changes from each of the component sections. (Hevner A. R., 2007)
While Hevner et al. (2004) defined the nature of design science research and Hevner (2007) expanded this idea further, there was significant room for the development of the concept of how design science research should proceed. Building from the guidelines set by Hevner (2004), Peffers, Tuunanen, Rothenberg, and Chatterjee (2007) proposed a six-stage framework (Figure 4) further expanding on the concept of a cyclic design cycle along with four distinct entry points for design science research. This framework is referred to as the Design Science Research Methodology Process Model (DSRM). Additionally, this framework serves to offer researchers a means of positioning their research as design science research allowing them to legitimise design science research via a commonly accepted process (Peffers et al., 2007). The authors believed that this framework would also provide guidance to reviewers when considering research presented as design science research (Peffers et al., 2007).

As can be seen in Figure 4, the first activity of DSRM process focuses on defining the research problem and the motivation of the research. Unlike the succeeding activities in DSRM, the first activity is not part of the process iteration. As such, any significant changes made to the core definition of the problem would most likely require that the process be started anew. Throughout the first activity of DSRM process, the aim is to define the research problem and justify the solution. To achieve this, the problem is split into many smaller parts to fully encompass the complexity of the problem. By doing this,
the created definition and solution should encapsulate the expected outcome of the process. However, the authors did note that solutions cannot necessarily be directly translated from problem, as the process of design is one of incremental improvement of available solutions. (Peffers et al., 2007)

From the problem definition, it is then possible to proceed to the second activity of DSRM process whereby the objectives of the solution are defined. While defining these objectives it is important to consider what is needed, what is possible, and what is feasible. Additionally, the state of comparable solutions should also be considered allowing for comparison between existing options versus the expected artefact. The objectives of said artefact should be clearly defined. To achieve this, it is possible to employ qualitative measurements e.g. expected working hours saved and quantitative descriptions as to the expected functionality of the artefact. Regardless of the combination of measurements used, the final objective is to offer a concise overview of the solution to the previously defined problem. (Peffers et al., 2007)

The third activity of the DSRM process focuses on the creation of the artefact itself. Using the solution objectives defined in the second activity, the aim is to produce an artefact that allows for demonstration of application and comparison to the desired solution. Achieving this is a two-part process. First the desired functionality of the artefact must be determined along with any resource requirements. Then the artefact must be created. Most likely, the artefact will fall under one of the classifications in as much as they will be either DSRM constructs, models, methods, or instantiations. One particularly important resource for this activity is knowledge of viable theories or practices that are applicable to the desired solution. By implementing these, it is possible to develop an artefact that meets the requirements of the solution objectives from the second activity with the aim of meeting the requirements of the original problem. (Peffers et al., 2007)

The fourth activity in the DSRM process demonstrates how the artefact created during the third activity relates to the solution objectives of the second activity. It should be noted that this demonstration is does not need to show that the artefact answers completely to the original problem. Instead, the aim is to show exactly what the artefact does in its current iteration, how this relates to the expected solutions, and to consider if the artefact needs to be further expanded or refined. The demonstration of the artefact can take a variety of forms including simulations, case studies of use, or conceptual proofs. (Peffers et al., 2007)

Once the artefact is demonstrated, it is necessary to assess the artefact in relations to the expected solution of the problem. To achieve this, comparison can be made between the results observed from the artefact in use compared to the expected outcomes of the solution. This can include comparison against the solution objectives of the second activity, performance measurements, or the achievement of conceptual goals. The main aim is to decide if the artefact sufficiently meets the requirements of the original problem or if the research should be iterated back to an earlier point in the activity sequence to improve the artefact further. This can mean better redefining the solution objectives of the artefact or further development of the artefact. However, if the artefact is considered sufficiently developed or the project is at a natural end then it is possible for the researchers to continue to the sixth and final activity of the DSRM process. (Peffers et al., 2007)

The sixth activity of the DSRM process involves the communication of several key points. In addition to identifying the importance of the problem, care should be taken to explain the novelty and utility of the artefact, the rigor of the design, the effectiveness of
the solutions found alongside information relevant to the target audience. It should be noted that the nature of the communication, its form and substance, will largely be dictated by the targeted audience. While scholarly articles may call for a more rigorous examination of the research work, organisations are more likely to be concerned with the practical application and development of the artefact. As such, this final activity requires that the research has sufficient knowledge of the disciplinary culture of the publishing environment. (Peffers et al., 2007)

Alongside the six main activities of the DSRM process model, there are also four identified points of entry for research. As can be seen, the first four nominal activities of the model coincide with four entry points. The first of these is the Problem Centred Initiation. By identifying an existing problem, researchers can seek to create an artefact that responds to the given needs of the problem. Problem centred solutions, as the name suggests, consider the problem to be the driving force behind the research. As can be seen in Figure 4, a Problem Centred Initiation guides the research towards the first activity of the DSRM process model recognising that while a problem exists, its motivation and definition are required. (Peffers et al., 2007)

However, in cases where the motivation and definition of the problem already exist, it is possible for researchers to focus on the second entry point of an Objective Centred Solution. Using a predefined problem definition gives rise to the opportunity to focus solely on the solution to the problem and the expected capabilities of the artefact. In general, Objective Centred Solution will come about due to a pre-existing research or industry need. (Peffers et al., 2007)

The third and fourth research entry points in the DSRM process model are dependent on the pre-existence of an artefact. Entry point three focuses on a Design & Development Centred Initiation. Through this, the aim is to extend and improve the functionality of an artefact to better serve its problem domain. With entry point four, the artefact is fully formed and operational in its problem domain. This Client / Context Initiated research aims to retroactively provide proof that the artefact is a suitable solution to the problem domain it has been deployed in. Often, the aim here is to show demonstrably proof of the viability of the artefact within an industry setting. (Peffers et al., 2007)

3.2 Agile Software Development

Traditional software development often employed a Waterfall Development Life Cycle (WDLC, figure 5) where set of sequential steps where used to create a software artefact (Royce, 1970). However, as software became increasingly complex significant problems became apparent in using the waterfall. Some noted that it can be challenging to gather all requirements from customers and that changing the requirements or requesting additions during while using the WDLC was challenging (Pressman, 2014, pp. 42-43). Additionally, the rise of the global economy has changed the rate at which new markets have appeared and the speed at which companies must respond to changing consumer demands (Viscardi, 2013, p. 8).
In response to a growing need for responsive development methods, professional software developers began to seek alternatives. There is some debate regarding the exact point when Agile Methodologies began to gain prominence. For some, the work of Dr Winston Royce heralded the first significant movement towards a software centric development method aimed at replacing the assembly line process (Royce, 1970). However, there are arguments which can be made suggesting that Agile Methodologies have roots even earlier than Dr Winston’s work. Indeed, earlier work by Dr W. Edwards Deming shows similar thinking with the Plan Do Check Act cycle, although this was not focused solely on software development (Moen, 2016).

For many, however, the accepted start point of Agile is the publication of the Agile Manifesto in 2001. Resulting from the work of 17 prominent software developers, the Agile Manifesto offered a defining vision of software development along with twelve core values.

“We are uncovering better ways of developing software by doing it and helping others do it. Through this work we have come to value:

Individuals and interactions over processes and tools
Working software over comprehensive documentation
Customer collaboration over contract negotiation
Responding to change over following a plan

That is, while there is value in the items on the right, we value the items on the left more.” - (Beck, et al., 2001).

It is worth noting that the Agile Manifesto presented a set of shared principles and values rather than an absolute roadmap (Asproni, 2006). Instead, the manifest could be considered as a philosophy of change for software development (Pressman, 2014, p. 67). Some go as far as suggesting that adopting Agile methodologies focus more on changing the mindset of software development teams rather than just their working practices.
(Stellman & Green, 2014, pp. 2-5). However, at the core is an iterative development process aimed at improving software and software design teams (Pressman, 2014, pp. 66-67). Although similar to the WDLC in terms of content and starting point, the majority of Agile process steps away from the sequentially model in favour of a cyclic development (figure 6).

Compared to traditional software development, Agile offers several advantages. For example, some believe that it improves team work by fostering trust and honesty between team members (Rover, Ullerich, Scheel, Wegter, & Whipple, 2015; Petersen & Wohlin, 2009; Highsmith & Cockburn, 2001). There has also been suggestion that this improves knowledge transfer between team members (Petersen & Wohlin, 2009) along with improvements in product quality (Rover, Ullerich, Scheel, Wegter, & Whipple, 2015; Reifer, 2002), and cost reductions (Reifer, 2002). In part, this could be due to an increase in customer involvement. While the traditional software development method tended to have customer involvement at the beginning and of the development, Agile encourages close cooperation throughout (Sutherland, 2012). Overall, this is believed to improve the customer focus and appreciation for the product as the process can adapt to changes in customer requirements. This ability to adapt rapidly to change is considered by some to be one of the strongest features of Agile development (Leau, Loo, Tham, & Tan, 2012; Highsmith & Cockburn, 2001).

While there are several Agile Methodologies available, the development of the Oulu Business School information system was conducted using scrum. As such, the remainder of this chapter will explore the fundamental aspects of scrum, explaining the key values, features and roles in a scrum development.

3.3 Scrum development

Scrum was designed as an iterative development framework which was heavily influenced by the production practice of Japanese car manufacturers. The aim was to improve product development in such a way as to iterate new products faster and more effectively. It is considered an empirical process control as neither the project scope development processes are generally left unchanged. Over short development cycles, small incremental changes are used to produce increasingly more complete version. At the end of each cycle, the product and processes are inspected and adapted to improve the development process. (Sutherland, 2012)
The Scrum team should not be confused with the development team (Viscardi, 2013). In general, the Scrum Team will contain the Product Owner, Scrum Master, and the delivery team members whereas the scrum delivery team is only the technical team (Viscardi, 2013). As a rule, the scrum team will be empowered and self-organised (Abrahamsson, Salo, Ronkainen, & Warsta, 2002). Rather than a top down managerial approach, the entire scrum team is involved in planning, estimating, and committing to their work (Viscardi, 2013). For most scrum teams, the aim is to deliver a potentially shippable product increment at the end of every sprint (Viscardi, 2013).

During scrum development, the Product Owner takes the responsibility of identifying and prioritizing product features to offer the best return for their organization (Sutherland, 2012). Even in the case of an internal development, the Product Owner must aim to maximize the value of development resources by ensuring that they understand the needs of their users (Sutherland, 2012). This means that the product owner is ultimately charged with the success and development direction of the product (Viscardi, 2013). It is worth noting that the Scrum Master and the Product Owner should never be the same person (Sutherland, 2012). Occasionally, the Scrum Master may need to act as a guard against changes to the team’s workload in the middle of a cycle, something which would not be possible if they are both Scrum Master and Product Owner (Sutherland, 2012).

With regards to the role of the Scrum Master, it should be noted that the Scrum Master is not a manager. Instead, the Scrum Master fulfils a servant-leader role, by helping to keep the development team focused while also protecting them from outside interruption (Viscardi, 2013). The Scrum Master is essentially the means of both safeguarding the development process to allow the development process to progress steadily. The Scrum Master also acts as a facilitator during all scrum meetings, ensuring that the team has a commonly shared vision of the product. Additionally, the Scrum Master may also be called upon to help the Product Owner organise and prioritize the backlog. Overall, it is the task of the Scrum Master to provide whatever help the development team or Product Owner requires to produce a viable product (Sutherland, 2012).
The product backlog represents the all the features that the product owner, and other stakeholders, would like to see developed. There is no limitation on its size or the outlandishness of the features that can be placed into the product backlog. It is the product owner’s responsibly to curate this list. All items contained in the product backlog must be ranked according to priority or urgency dictated by the product owner. throughout the development process, a product owner is free to assigned whatever priority they feel is appropriate. However, once the development team have locked the work for the next sprint, that cannot be changed. As such, any rearrangement of priority at that point is panning for the next sprint. (Viscardi, 2013, p. 23)

The priority of the current items in the product backlog is of particular importance during the sprint planning meeting. During this meeting, the highest priority items will be selected from the product backlog and the team will plan the means to implement the selected items. Generally, the sprint planning will be conducted in two parts. During the first, the product owner will present the highest priority items and discuss any questions the development team may have. The scrum team conducts the second part of the sprint planning, deciding on how many of the highest priority feature can be implemented and the available resources for development. (Viscardi, 2013, p. 20)

The sprint backlog represents a rough approximation of one sprints worth of work for the development team (Stellman & Green, 2014, p. 42). It is entirely owned by the scrum team and contains all the product backlog items that the team committed to developing (Viscardi, 2013, p. 24) The team update this daily to reflect the current status of the development (Viscardi, 2013, p. 24) Additionally, team members can remove, add, or change tasks on the sprint backlog to better reflect the needs of the sprint (Viscardi, 2013, p. 24).
4. Design Process

This chapter explains the methodology used throughout the development of the OBSIC system. Included is a detailed analysis of each of the component parts of the development cycle.

4.1 Overview

Alongside the development of the OBSIC system, this research hoped to show the areas where Scrum and the design science research methodology framework overlapped and could be used in conjunction. The key areas of this overlap can be seen in figure 8.

While developing user stories into a product backlog, it was possible to also consider these as the objectives of the solution. As is, user stories generally cover the major expected features of a product and thus could also be considered the products objectives. Furthermore, when evaluating the efficiency and effectiveness of an artefact, the product back log can be used as a comparison point. For example, if a product backlog contains 100 items and only one is complete, the artefact can probably be considered as inefficient and ineffective. Similar overlap is also visible between scrum sprints and the design and development / demonstration phase. At the end of any given sprint, the artefact must be demonstrated and accepted much in the same way as suggested by framework.

4.2 Changes to scrum

To employ scrum methodologies, certain changes were required. Most these changes were due to the size of the development team, since there was only one member. The daily scrum meeting was not required nor was the sprint retrospective. To compensate for this, discussion with the product owner regarding the development of the OBSIC system tended to be extensive. Fortunately, there was a very high level of involvement from the product owner throughout the development. This mean that the system conformed to the expectations of the customer rather than the vision of the developer.

The role of the scrum Master also required adaptation as the scrum Master was also the scrum team. Similar to De Bono’s (1999) six hat concept, it was necessary to have different hats throughout the project. However, there are acknowledge risks to this. Task
switching costs (Kiesel, et al., 2010; Monsell, 2003) mean that development time is lost as the developer changes from one task to another. This is particularly noticeable if there are repeated intrusions within a short space of time (Kiesel, et al., 2010). To overcome this, the main duties of the Scrum master were relegated to first thing in the day. Communication regarding the project was only conducted at the start of business with the rest of the day dedicated to developing the system. As Keisel et al. (2010) noted, this significant reduced the disruption to development.

4.3 Scrum Parameters and Artefacts

For this project, it was decided that each sprint would run for two weeks. It was felt that this would offer enough time for new features to be implemented and assessed without allowing the sprints to run overly long and potentially face challenges from changes in the requirements. As such, there was a total of 10 sprints running over 20 weeks. The remaining four weeks was given over to planning and post-deployment bug fixing.

During the start of the project, the Scrum Team meet to discuss roles and development. As the most senior representative of Oulu Business School, Pasi Karjalainen took the role of Product Owner. Initially, the Scrum Team developed 50 user stories covering the major features of the OBSIC system. However, during the development process, one of the user stories would be divided into multiple individual parts and new reports would be requested. As such, the final user story count was 61. Each of these stories followed the standard format of “As a / I want to / So that”, an example of which is seen below (figure 9).

<table>
<thead>
<tr>
<th>As a …</th>
<th>I want to …</th>
<th>So that …</th>
</tr>
</thead>
<tbody>
<tr>
<td>User</td>
<td>Record published international peer reviewed journal article</td>
<td>My contributions can be correctly reported</td>
</tr>
</tbody>
</table>

*Figure 9 Example “As a / I want to / So that” user story.*

These user stories were used as the basis of a prioritized backlog. Here, features were given a priority between 1 (very high) and 5(very low). Due to the small size of the development team, there only one sprint planning meeting. During this, the scrum team sat together and discussed the highest priority items. These items were then expanded and rough estimates were given for the time required. Although generally not encouraged, previous experience with the OBSIC system development allowed for general time requirements to be used. While story points, or some other metric, may have been preferred, the general inexperience of the team made this unfeasible. An expanded sprint backlog task is shown below (figure 10).

<table>
<thead>
<tr>
<th>User Story</th>
<th>Task</th>
</tr>
</thead>
</table>
As a user, I want to record published international peer reviewed journal articles so that my contributions are correctly recorded. The table below lists the tasks involved in this process:

<table>
<thead>
<tr>
<th>Task Description</th>
<th>Design and code database schema</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Design HTML input form</td>
</tr>
<tr>
<td></td>
<td>Validate User Input</td>
</tr>
<tr>
<td></td>
<td>Store input in database</td>
</tr>
</tbody>
</table>

*Figure 10 User Story expanded for the sprint Backlog*

### 4.4 Entry Point for design science research

For this research, it was necessary to adopt a problem centered initiation. While the existence of a software artefact from the original project offered the potential of an objective centered solution, it was not considered a viable starting point. During the original project, insufficient resources had been applied to the proper identification of the problem, the motivation behind the project, and the needs of the Oulu Business School. As a result, the artefact produced by the project failed to meet several key requirements.

Additionally, changes to the requirements of the AACSB reports meant that the data collection needs of Oulu Business School were no longer the same. Consequently, it was deemed appropriate that the project begin by defining the overall needs and goals of the system, focusing on creating an artefact designed to meet the needs of Oulu Business School.

### 4.5 Problem Identification and Motivation

To understand the problem faced by Oulu Business School, and thereby the motivation for change, it was important to consider the way in which data was being collected, the users that it was collected from, and the way in which it was processed to create valuable information. During the initial phase of AASC'B accreditation, all staff members maintained an individual portfolio of intellectual contributions. These portfolios comprised of a spreadsheet workbook containing the staff member’s intellectual contributions as well as a collection of word documents and spreadsheets detailing the any theses that the staff member had overseen.

Since members of the accreditation team were also active members of the Oulu Business School faculty, they maintained their own intellectual contribution portfolio. In addition to this, they were also responsible for updating information regarding external contributors to the Oulu Business School. Generally, only one or two members of the team were responsible for maintaining the external contribution information as the portfolios were stored locally rather being shared. Consequently, some members of the accreditation team were handling a large amount of data which occasionally proved difficult to keep updated and accurate.

There were also additional challenges faced through the potential loss of data. Due to a lack of a single share repository for the intellectual contributions, the loss of a single faculty member’s portfolio could represent a significant loss of working hours. Also, there were challenges faced when dealing with the information for former staff members. While they may no longer be employed by Oulu Business School, their contributions must be recorded for the entire time that they were present. If a staff member left without updating
or handing over that information, the accreditation of the Oulu Business School could suffer.

By far the most difficult challenge faced was staff member contributions came from external members of staff, such as visiting lecturers. While they are an active faculty member, any contribution to the school must be recorded. This proved to be challenging to maintain when collecting on an annual basis as the staff may not have been available to provide the necessary information. In addition to this, some external faculty members were present for an extremely short amount of time and were no longer active when the annual report data was gathered.

Both the accreditation and managerial teams faced challenges when reproducing or altering reports. While certain aspects of this could be automated, a larger portion was still achieved through manual labour.

4.6 Definition of Objective Solutions

After considering the problems faced by the Oulu Business School, the objectives of the solution were the creation of a management information system that will collect data regarding the intellectual contributions of faculty members and process this into viable reports. The system should collect all pertinent data, as defined by the managerial and accreditation teams, and produce time specific reports according to their needs.

4.7 Design and Development

The design and development of the OBSIC system was conducted over a period of five months. During this time, 10 sprints were completed. Except for Sprints 2, 4, and 8, all the sprints were completed without incident. For brevity, only the notable sprints have been expanded upon here.

During sprint 2, illness meant that almost half of the available development time was lost. Because of this, the several tasks from the sprint backlog for Sprint 2 were returned to the product backlog. Overall, this did not have a negative impact on the development process. However, it did mean that the product backlog had to be reviewed prior to the sprint planning for Sprint 3. After discussions with the product owner, it was decided that the product backlog would remain unchanged and, if necessary, lower priority items would be scraped completely.

At the end of Sprint 3 and prior to the beginning to Sprint 4, there was a meeting with the development team and the accreditation team. Due to changes in the AACSB requirements, certain classifications of intellectual contributions were removed from the backlog. Additionally, one of the classifications was expanded from a generic umbrella classification, essentially a miscellaneous class, into 6 defined classifications. Further to this, the managerial team of Oulu Business School had requested that three new reports be added into the system. Because of this, it was necessary for the product backlog to be reorganised and reprioritised.

Finally, at the beginning of Sprint 10, a substantial error from a previous sprint was discovered. Unfortunately, this error impacted three of the major reports generated by the OBSIC system and required priority attention. Fortunately, the development was on schedule and these bugs could be fixed. However, due to the time requirements, the remaining low priority features on the product backlog were not developed.
4.8 Demonstration

At the end of each sprint, members of the accreditation team were shown the OBSIC system in its current state. The aim here was to show how the system had developed and to ensure that the system was meeting the expectation of the Oulu Business School. Additionally, we had an opportunity to demonstrate the system during an all hands faculty meeting. By this point, the system was complete functional from a user point of view as all the priority features had been implemented. As such, this was a chance for the staff to see how the full system worked, offer feedback, and ask questions.

4.9 Evaluation

In order to evaluate the OBSIC system, a number of methods were adopted. Throughout the development, the system features were compared to the product backlog to gauge how close the system was to meeting its objectives. Overall, progress was steady and this comparison allowed easier communication to the accreditation team regarding the overall development progress. Additionally, comparing the completed features to the remaining essentially allowed the artefact to be judged against its objectives.

In addition to this, a user survey and structured interview was conducted. Using a synthesis of concepts from the works of Sugianto & Tojib (2007), Kekre, Krishnan, & Srinivasan (1995), and Wixom & Todd (2005) a number of key areas of evaluation were identified. These were efficiency, usability, ease of comprehension, responsiveness, training and satisfaction. Consequently, both the survey and the interview focused on these areas. The results of these evaluations are discussed in section 6.

4.10 Communication

The main communication for this project was the creation of this thesis. Also, throughout the development process, the OBSIC system has been presented to a variety of faculty members through demonstrations and presentations. As such, communication required tailoring in accordance to the interests and technical aptitude of the audience.
5. **OBSIC System Overview**

This chapter describes the IT artefact as experienced by both Users and Super Users. For conciseness, features shared by Users and Super Users are detailed within the User System section. As such, only features which are wholly limited to super users will be discussed in section 5.2. Additionally, it should be noted that while the included screenshots of the system are representative of the active system, the information displayed is has been altered or blurred to preserve user privacy and data security.

5.1 **User System**

Prior to the creation of OBSIC, information pertaining to the intellectual contributions of staff was primarily collected via a system of individually updated spreadsheets and word processing documents. From the user perspective, there were several key issues with this. For example, if mistakes were made during the initial recording of an intellectual contribution, it could remain unnoticed or challenging to correct. This would then influence the assessment of a staff member’s sufficiency i.e. their role within their department and the faculty. It was unacceptable that corrections could not be made quickly or easily. Additionally, the loss or corruption of either the collated files or the file of an individual user could potentially see the loss of hours of work. While the IT infrastructure of the University offered some protection against such mishaps, it is common for users to work on their own devices. Thus, backup protection through the University of Oulu IT system is not guaranteed.

As such, one of the main aims of the OBSIC system was to offer faculty members of the Oulu Business School an easy way to maintain a portfolio of intellectual contributions within a secure database. This would allow users to maintain an up-to-date record of their intellectual contributions to Oulu Business School while also offering data protection through daily backups. As mentioned previously, the majority of the features required by the users were pre-defined by the needs of the managerial staff of Oulu Business School. Most the intellectual contributions recorded through the system where defined entirely based upon the requirements of the AACSB, although some, such as submitted journal articles, were entirely based on the needs of the Oulu Business School.

5.1.1 **User Login**

Among the first requirements of the system was the creation of a single user identity for accessing OBSIC. When a new user account was created, the user was given a unique username and password. For users, this offers a means of securing and retaining control over there information. While a large portion of the information stored on the system is available publicly, there are some areas, such as historical position or responsibility information that is not. Additionally, the secure login system also secured access to the OBSIC system by redirecting any unauthorised users to the login page. The initial design for the login procedure can be seen below (figure 11).
With a recognised need for security, several protections were put in place to guard against unauthorised access. In brief, information regarding the existence of a specific account was never reveal. Instead, users received confirmation that a password reset request has been sent. During the development, there was also a limit on the number of incorrect passwords that a user could try. However, this proved to be problematic and was eventually removed.

5.1.2 User Details

The user details are only every requested once. After that, the user details are only every updated by the user themselves or, in extremely rare circumstances, by the system administrator. When add or updating information, the user is presented with the form below (figure 12). If there is no pre-exiting information, this is blank. However, if a user account exists, the user will be shown their most current information.

Most the information that is collected is used by the managerial team. However, information regarding the user’s position, highest degree, sufficiency, and time spent devoted to the mission of Oulu Business School are all taken into account by the AACSB reports.
5.1.3 User Responsibilities

As part of the AACSB accreditation process, Oulu Business School must provide information regarding the normal duties of each faculty member. While the user detail form records the user’s current duties as of the first year when they use the system. Oulu Business School requires a historical log of a user’s normal responsibilities for each year of employment. Users can provide this information through the form shown below (figure 13).

![Figure 13 User Normal Responsibilities.](image)

Initially, this information was requested through a notification on the user’s summary page. However, after negative feedback regarding the noticeability, this was changed to require that users update these details when they log in. While the user can skip this process twice, on the third login they must update these details.

5.1.4 User Position Information

Initially, the user position information was only recorded for the current position that the user held. However, during the development process, the managerial team requested that this be collected on an annual basis with a historic record of a user’s positions in the Oulu Business School. To achieve this, users were given an onscreen notification on their summary that this information was required. While testing this, users felt that it was too easy to ignore and the managerial staff requested a more noticeable solution.

![Figure 14 Position information update request](image)

To keep the position records up to date, a new login procedure was added. When a user logged in, the system checked if all their position information was present. If it was not, the user would be redirected to the position information update request page (figure 14). This would remind users to update this information. There was some discussion regarding the number of times that a user could skip this. While there were some differences of
opinion, it was eventually agreed that users should be encouraged to supply this information rather than be forced.

5.1.5 User Controls and Navigation

The user controls provide access to several features for users (figure 15). Navigation is presented at the stop of each screen the users visits and allows users to easily switch between the each of the main areas of the website and the ability to securely log out of the system.

![Figure 15 Basic user navigation panel](image)

This control panel also displays an overview of the user’s information and grants the user editing access to their details, position, normal duties, and password control. For super users, an additional set of navigation tools is shown (figure 19). These controls grant super users access to additional features which will be discussed later.

5.1.6 Contribution Summary

The contribution summary show a user a full list of the contribution that they have recorded in the OBSIC system. It can be filtered by year or over a period of years, depending on the needs of the user. This is aimed at providing concrete information to faculty members regarding their own contributions. At a glance, users can see what they have added possibly noticing any missing information (figure 16).

![Figure 16 User Contribution Summary](image)
For super users, the summary of other faculty member’s contributions is available. Presented in a similar form and with similar filtering options, it offers super users the chance to view the contributions of any individual.

5.1.7 Add Intellectual Contribution

For users, the ability to record their intellectual contributions is the most fundamental feature offered by the OBSIC system. Users have access to the full range of attributed intellectual contributions. This list is comprised of all the intellectual contributions that AACSB require records of as well as one solely for the use of the managerial staff (figure 17). A full list of these contributions can be seen in appendix 2.

5.1.8 Edit and Delete Intellectual Contribution

The editing functionality is self-explanatory. The user is presented with a filterable list of contributions from which they can select to edit or delete. An example of this is shown below (figure 18). Users select the contribution they wish to edit and are presented with a form that helps. Deletion, an on-screen prompt confirms that the user wishes to delete the contribution. Super users can delete the contributions of any user of the system.

The ability to edit and delete contributions was a topic that the development team, accreditation team, and managerial team all discussed at some point during the development. Some felt that allowing the users to delete their work could lead to problems, especially if a staff member leaves on poor terms. Others felt that giving users full control over their information would lead to a higher degree of user acceptance of the system. After some debate, it was decided to allow users to delete their own contributions at will.

5.2 Super User System

One of the immediate differences between the user and super user systems is the navigation bar. As can be seen in figure 19, an additional eight options are presented to super users which give access to several important tools.
Super users can create new user accounts. After supplying a username, an email address, and a user type, the system automatically sends the new user an email containing their username and password. This avoids the super user having to either manually generate a password or contact the users. As mentioned previously, the super users also can see a summary of the intellectual contribution of any user and delete erroneous contributions. Additionally, they may also flag a user account as active or inactive. This allows for non-contributing faculty members to be removed from reports. Super users can also set the user sufficiency which indicates the nature of their role in the Oulu Business School.

The course overview was a late addition to the OBSIC system. Essentially, all courses taught within the Oulu Business School have their hours divided among the teaching tasks on a percentage basis. Whenever a user adds course teaching duties to their intellectual contributions, the system checks to see if that course already exists and if enough unallocated time remains. In case of conflict, super users can view a summary of any recorded course along with information regarding the claimed hours.

However, the main purpose of the OBSIC system is to provide super users with the means to easily create reports based on the intellectual contributions of staff. These are divided between administration reports and secretarial reports. All the reports are produced as comma-separated value files. This allows the reports to be manipulated using any spreadsheet program. All of the reports required for the AACSB accreditation were implemented along with a number of managerial and secretarial reports requested by the Oulu Business School.
6. Evaluation

The evaluation of this research was conducted at the end of each sprint in the development process. In addition to this, a structure interview with the super users was conducted when the system was fully deployed and in use. A user survey was also performed.

6.1 Scenario Evaluation

In addition to the guidelines of what constitutes design science research, Hevner et al. (2004) also provided guidelines for evaluating artefacts created. While this research provides a case study for the OBSIC system, it does not offer viable means for a study of the artefact in use. However, Hevner et al. (2004) also suggested the use of scenarios for evaluation. Extrapolating from this idea, the user stories for the development of the OBSIC system could be considered as scenarios as they offer both a problem, in terms of what the user wants to achieve, as well as an acceptable solution. The table (table 3) below details a comparison between the user stories and the features contained in the OBSIC system.

<table>
<thead>
<tr>
<th>User Type</th>
<th>Total User Stories</th>
<th>Complete</th>
<th>Incomplete</th>
</tr>
</thead>
<tbody>
<tr>
<td>User</td>
<td>41</td>
<td>40</td>
<td>1</td>
</tr>
<tr>
<td>Super User</td>
<td>20</td>
<td>19</td>
<td>1</td>
</tr>
</tbody>
</table>

*Table 3 Comparison of complete and incomplete user stories*

As can be seen, the clear majority of user stories were brought to a state of completion. Consequently, it can be argued that the artefact meet the objectives of its solution.

6.2 Super User Evaluation

As part of the evaluation of the Oulu Business School information system a short, structured interview was conducted with two members of the accreditation team. The aim here was to allow the super users to provide their own feedback regarding the system, its capabilities, and points where there is room for improvement. The transcript of this interview has been provided as an appendix. Both were heavily involved in the design and development of the system and will be the primary users of the reporting features provided by the Oulu Business School information system. Having been involved with the collection of data for the accreditation process from the beginning both interviewed super users were unhappy with the original data collection method. They felt that the older data collection system demanded too much manual work and made it very challenging to create different reports.

Both envisaged a system that was visually clear and simple for users to use. Additionally, they felt that users should be able to see a historical record of their contributions along with the ability to edit or delete any of the information that they had provided. For super users, they wanted to be able to create reports from a variety of points from individuals,
departments, and faculty levels. Additionally, they wanted the ability to view a full summary of user contributions. When discussing the OBSIC system, both super users expressed satisfaction with the capabilities and efficiency of the new system. They felt that the collection of information was improved by spreading it across the year. The reduction of manual labour required and the scope and variety of the available reports were also considered satisfactory.

6.3 User Evaluation

The user evaluation was conducted after the OBSIC system had been introduced to the staff and was full in use. Most the questions were based on the Likert Scale (Likert, 1932). Respondents were offered a selection of 5 choices in a range of questions covering key areas identified section 4.9. These included efficiency, usability, ease of comprehension, responsiveness, training and satisfaction.

One of the first areas of interest was the length of employment of respondents. Although, all members of the faculty should be aware of the AACSB accreditation, the data collection process, and the OBSIC system, it is more likely that long term staff members would have a broader understanding of exactly what this entails. As can be seen in Figure 20, over half of respondents were employed by Oulu Business School for more than 5 years. Consequently, these staff members should have been involved with the AACSB accreditation process from the beginning.

<table>
<thead>
<tr>
<th>Length of Employment</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>less than 1 year</td>
<td>2</td>
</tr>
<tr>
<td>1-2 years</td>
<td>9</td>
</tr>
<tr>
<td>3-4 years</td>
<td>8</td>
</tr>
<tr>
<td>more than 5 years</td>
<td>32</td>
</tr>
</tbody>
</table>

Figure 20 Length of employment with Oulu Business School

Respondents were then asked if they had participated in the collection of data for the AACSB prior to the introduction of the OBSIC system (figure 21). Unsurprisingly, most those employed for less than 5 years had no experience with AACSB. However, there was a significant portion of those that had long service with Oulu Business School reported that they had no prior involvement in the collection of data for AACSB. There is no clear explanation of why these faculty members would not have had any involvement. When discussing this with the accreditation team, no reasonable answer could be offered. However, the anonymous nature of the survey precluded any request for clarification from the respondents.

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>less than 1 year</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>
Figure 21 Prior involvement in the collection of data for AACSB accreditation

Any of the respondents who had been involved in the collection of AACSB contribution information were then asked to consider if they felt that the OBSIC system was more efficient or less efficient than the previous method of data collection. On analysis, the mode value for the respondents was 4 meaning that the respondents felt that the OBSIC system was more efficient. As can be seen in Figure 22, the majority of respondents felt that the OBSIC system was an improvement.

![Efficiency of the Oulu Business School Intellectual Contribution System](image)

Users were then asked to consider how challenging they found the OBSIC system to use. As can be seen in Figure 23, the respondents neither found the OBSIC system challenging or easy to use which is borne out when by a mean of 3.03. Although this result is not disappointing, it does suggest that there is significant room for improvement in the OBSIC system. In all likelihood, this would be achieved by further development of the system with greater user involvement throughout.
In a similar manner, users were asked about the ease of navigating the OBSIC system to gauge how usable the system is. As can be seen from Figure 24, the results were mixed. Although a large portion of the respondents agreed that the system was easy to use, a significant portion either did not or were indifferent. It appears that this is an area where significant improvement could be made and is something that should be considered for future development.

Asking users about their perception of the look and feel of the OBSIC system produced some interesting results. While approximately 41% of all respondents felt that the look and feel of the OBSIC system meet their expectations, a similar number were ambivalent to the design (Figure 35).
On reflection, it is possible that the way in which the users were asked this question was too ambiguous to produce meaningful results. If this study is repeated, it may be necessary to consider phrasing the question better. However, it may also be that a large portion of the respondents are indifferent to the design of the OBSIC system. Much like the ease of use, this could be addressed with further development.

Users were also asked about their own understanding of the information collected by the OBSIC system. This was aimed here was to check if the users comprehended the need for the system that they were using. As can be seen in Figure 26, the majority of users understood this. However, for future development, it may still be worth improving the availability of information regarding OBSIC system and its uses in order to ensure all of the users understand what information is being collected and why.
such, the users were asked if the pages of the OBSIC system loaded quickly when they were accessed.

![Figure 27 Page loading speed](image)

As Figure 27 shows, most users felt that the website responds quickly. However, when analyzed, the responses have a mode of 3.9. Although this indicate that the users agree, it also suggest that this may be an area which should be revisited as the system is expanded. It may be worth dividing this question into two where users can be asked how quickly the OBSIC system loads for them and how quickly the input areas, such as forms, respond to them.

![Figure 28 sufficiency of training](image)

While the training for the OBSIC system is somewhat outside of the scope of this research, it was an area of importance identified in section 4.9 and one of the areas of interest for Oulu Business School. As such, users were asked if they believed that they had received sufficient training in the use of the OBSIC system. As Figure 17 shows, the majority felt that there had been. However, a large portion of the respondents were indifferent (31%) or responded negatively (15%). Although this could have been an area for concern, it should be noted that this survey was conducted at approximately the same
time that users were receiving training to use the OBSIC system. As such, it may be that revisiting this question at a later point would produce more positive results.

![Bar chart showing overall satisfaction](image)

**Figure 29 Overall satisfaction**

Finally, users were asked to rate their overall satisfaction with the OBSIC system (figure 29). Although a small portion were unsatisfied, the majority were satisfied or very satisfied. Considering the importance of the system to the Oulu Business School, this is a good response. For future development, it may be worthwhile to approach the indifferent users in order to improve the quality of the service provided by the OBSIC system.
7. Discussion

The aim of this research was to design a management information system to improve the data collection process of the Oulu Business School. To achieve this, the problem was studied Design Science methodologies proposed by Hevner et al. (2004) along with the Design Science Research Framework put forward by Peffers et al. (2007). This allowed the problem domain to be defined through rigorous use of the existing knowledge base as well as offering suitable means for developing the artefact itself. Overall, the OBSIC system was considered a success as it met all the requirements of the Oulu Business School and all the initially set objectives.

There was also interest in the areas where design science and Agile methodologies overlap. With Scrum, the core of the process is akin to the framework proposed by Peffers et al. (2007) with regards to an iterative design process. In both, an initial concept or idea is developed into a set of defined objectives. These objectives are then used to develop an artefact whose fitness is assessed through demonstration in context and comparison to the original objectives.

Additionally, there was interest in the advantages of combining these methodologies. In general, combining these methodologies have the potential to strengthen both. From DSR comes the encouragement to explore academic and professional literature to help create a more defined solution. This may allow for better products to be created or for unforeseen weaknesses to be addressed. On the other hand, Scrum provides a practical and tested framework for creating products. It is possible that this would increase the probability that projects are completed successfully.

However, there are some points of criticism that can be levelled toward this research. As was noted in the user evaluation, the overall level of user involvement in the design process was too low for a project of this nature. While the accreditation team did offer some representation for normal users, it is clear the system did not meet all the expectations of the users. While users appear to be satisfied with the improvements to the efficiency of the data collection, there were other areas where the system fell short.

Once such example is the overall look and feel of the OBSIC system, which received a neutral to positive reaction from the users. Similar reactions were found with the overall usability of the system. However, this was balanced by the fact that users clearly understood the purpose of the information that was being collected and were generally satisfied. By increasing the user involvement in the design process, it may have been possible to better meet the user expectations.

Some of the changes to the scrum may have led to inconsistency in the overall application. For a one-person development team, the daily scrum meeting offered no value. As mentioned, these were removed from the scrum process and, on retrospect, this may have been an unwise decision. Without the daily scrum meeting, certain problems that presented themselves during the development were not answered in a timely manner. With a larger development team, the daily scrum meetings would have been presents and it is likely that these problems would have been tackled differently.

Indeed, one of the most significant changes was a direct result of the size of the development team. Since there was only one member of the development team, it was necessary for one person to fulfil the role of both scrum Master and scrum Team. While this was possible, there were points where it is likely that this shared role incurred task
switching costs (Monsell, 2003; Kiesel, et al., 2010). It is also probable that this shared role also introduced unnecessary complications during communication with the product owner, accreditation team, or other stakeholders. Overcoming this required a clear demarcation between areas of responsibility. During any communication or meeting, it was necessary to discuss the project from the scrum Master position. Also, by using task preparation as suggested by Kiesel et al. (2010) enabled the overall cost, in terms of impact to the development time, to be reduced. Overall, however, it is likely that this shared role had a negative impact on the project.

Additionally, by having only one person to fulfil multiple roles, it is difficult to prove conclusively that the application of scrum methodologies is viable when conducting design science research. In retrospect, the changes to the methodologies may have moved the process slightly outside the accepted definition of scrum. Indeed, the extremely small size of the development team resulted in some core scrum activities being unusable. However, the overall process of iterative development was maintained and did prove to be effective both in terms of the development of the artefact and communication between the development team and the stakeholders. Beyond this, the core values of scrum were upheld. This allowed for clear communication, honest inspection, and rapid adaptability throughout the development life cycle.

Employing scrum methodologies in conjunction with the design science research framework did offer notable advantages. One example was that user stories and the product backlog offered a viable means of evaluating the current state of the artefact compared to the objectives of the solution. At each point of the development cycle, it was very easy to see how many of the features had been implemented and the remaining development required. As mentioned previously, the project represented a case study for the design. By applying the artefact to an existing business problem, it could be shown how the designed artefact meet the needs of an important and relevant business problem.

The knowledge base was also advantageous when developing the Oulu Business School system. By researching the problem domain prior to the start of development, it was possible to create a much clearer idea of the type of system that was to be built as well as the processes and methodologies available for designing and developing the system. This proved to be particularly useful when discussing the system with stakeholders as it offered terms and definitions necessary for creating a shared vision of what the system should be and do. In general, this meant that there were few points when a particular iteration of the system deviated from the needs of the Oulu Business School or the desires of the accreditation team. This was particularly true when considering exactly what kind of system we were developing. Although it was ultimately decided that the system would be a management information system, the ability to explain why this was and what it represented proved beneficial to the development process. Overall, the project suffered from very little feature creep (Rust, Thompson, & Hamilton, 2006; Elliot, 2007). Mainly, this was achieved by discussing the relative value of any new feature or requested change in terms of the value added versus the time required. While the scrum methodologies fully invited changes to the development, this needed to be balanced against the available resources.

As well as enhancing the commonly shared vision of the system, the knowledge base also helped overcome areas where the development team and the accreditation team were inexperienced. In the main, the accreditation team had limited knowledge of information systems and software development in general. By research the problem domain, it was possible to offer a much clearer definition regarding the development process as a whole. This was also true when discussing the iterative development of the system. Through the
backlog and sprint plan, the accreditation team, as well as other stakeholders, could be offered a very clear overview of what had been achieved, what was planned.

For the development team, the knowledge base provided significant information regarding several key areas of development, particularly with regards to security. By applying concepts and practices found through the development of the knowledge base, it was possible to create a more secure system.

Furthermore, understanding the incurred costs of task switching (Kiesel, et al., 2010) allowed the development team to plan in order to reduce these costs. As mentioned, all communication regarding the project was dealt with at the start of the day, allowing the remainder of the day to be dedicated entirely to the development process. It is likely that, if such changes had not been implemented, more development time would have been lost through switching between tasks and roles.

7.1 Limitations

It must be acknowledged that size of the development team was restrictive. As mentioned, the development team was limited to a single person with resulted in one person taking responsibility for a number of areas. It is possible that this could have been overcome by asking one of the members of the accreditation team to oversee the role of scrum Master. However, considering the relative inexperience of the accreditation team, it is unlikely that this would have produced desirable results. Indeed, it could be argued that such action would have presented Conway’s Law (Herbsleb & Grinter, 1999) in action whereby the addition would have slowed the overall development as an inexperienced faculty member was ask to oversee a challenging role.

7.2 Future research

For future research, it may be interesting to actively study the impact of small teams on the choice of development methodology and the overall impact on the relative success of projects. While de Bono (1999) argues that individual thinking is improved by understanding the differing ways in which the mind processes information, it could be interesting to consider how the expectations of a particular role influence those involved in a development project.

Further to this, it would be possible to approach this research using a larger development team. This would remove the need to make changes to the scrum development cycle and would perhaps offer more in-depth insight regarding the use of scrum in conjunction with design science. For example, would the daily scrum be a viable means of offering an evaluation of the overall project. While this could be burdensome, it may also allow the solution evaluation at a more granular level.

Another viable area of research could consider the use of other Agile methodologies. While this research focused on the use of scrum, most Agile methodologies focus on similar iterative development. As such, it is possible that similar overlap and complementation would be found. Overall, there are areas which remain unexplored by this research. While in theory, the suitability of using scrum and design science together has been shown, there is always room for improvement.
7.3 Evaluation as Design Science

As mentioned in section 3.1, there are seven guidelines proposed by Hevner et al. (2004) which represent their vision of what design science should contain. These guidelines are presented as bellow along with consideration of how this research fulfils these criteria.

Guideline 1: Design as an Artefact

Hevner et al. (2004) argued that design science research must produce a viable artefact, either in the form of a construct, a model, a method, or an instantiation. The outcome of this research was a complete system that significantly changed the way that the Oulu Business School collects data for its accreditation process. The system has been brought into use by the Oulu Business School and has seen use in producing the most recent accreditation reports for the AACSB.

Guideline 2: Problem Relevance

With regards to the problem relevance, Hevner et al. (2004) put forth that design science research should develop technology-based solutions to important and relevant business problems. As a web based management information system, the OBSIC system is entirely driven by information technology. It takes advantage of server based computing in order to automate an number of tasks that previously required significant manual oversight.

In terms of business problem relevance, there are two significant points that must be considered. Firstly, the OBSIC system has been taken into full use by Oulu Business School. The success of the system has been such that there has been further development and plans for future development to further expand the capabilities of the system. In addition to this, the accreditation team has discussed the possibility of offering the OBISC system to other business schools. Whenever the system has been discussed with other accredited business schools, there has always been significant interest. It is likely that this interest derives from similar concerns and challenges faced by Oulu Business School prior to the development of OBSIC.

Guideline 3: Design Evaluation

Evaluating the design was conducted in a variety of ways. Throughout the development, the current artefact was compared to the user stories, in effect using these as scenarios for evaluation. Additionally, both super users and user were asked to evaluate the OBSIC system. Some criticism could be directed to the way in which these evaluations were conducted near the completion of the system rather than throughout. However, as was mentioned in the limitations, there were external factors that influenced this.

Guideline 4: Research Contributions

This research offers three contributions. Firstly, it shows how a management information system can be effectively designed and developed to meet the needs of an organisation. Also, this research shows the effective overlap between design science research and iterative software development methods. Finally, this research shows the effect that extremely small teams have on Agile development and the ways in which the development methodology must be adapted.

Guideline 5: Research Rigor
This research was conducted using the Design Science Research Methodology framework proposed by Peffers et al. (2007) in conjunction with scrum development methodologies. Each step of this research was rigorously planned and based on both the needs of the business environment and the knowledge base.

**Guideline 6: Design as a Search Process**

This research took advantage of several available resources, both professional and academic to meet create an effective artefact. The knowledge base was used to define the type of information system that was to be built while also providing guidance on the evaluation of the artefact. The effectiveness of the artefacts is verified by the adoption of the artefact into the operations of the Oulu Business School.

**Guideline 7: Communication of Research**

The communication of this research was achieved through the publication of this thesis, discussions with the accreditation team, and presentation of the system to faculty members. This meant that it was necessary to communicate the research, progress, and value to a variety of audiences with varying levels of technical expertise.

While there are appreciable weaknesses in the fulfilment of the guidelines 3 and four, the guidelines are still fulfilled to a degree. As such, this research can be shown to match the guidelines set by Hevner et al. (2004).
8. Conclusion

An existing business need of the Oulu Business School motivated this thesis. While partial success with the creation of an information system had been achieved with prior projects, the created artefacts were considered, at best, a proof of concept. Consequently, the Oulu Business School still required a management information system which would reduce the manual work requirements for AACSB reports and improve the overall data collection process. By employing design science research, it was possible to construct a detailed analysis of the requirements of Oulu Business School and model these into a set of objectives for the system. These requirements were extrapolated further, using Agile methodology, into a concise list of user stories which would form the backbone of the development process.

Ultimately, this research produced a fully-fledged system which has entered full use by the Oulu Business School. The main objectives of improvement and reduction of manual oversight have been achieved. Further to this, the system has proved so successful that Oulu Business School has continued developing OBSIC and is considering the possibility of offering the system to other accredited schools.
References


Appendix 1 - OBSIC Super User Interview Transcript

What is your role in Oulu Business School? How long have you been employed by Oulu Business School?

SU1: Controller at Oulu Business School. I have been in different teaching and research positions between years 2002-2011. Since 2011 I have been in controller position.

SU2: Senior research fellow. I have been in different teaching, research positions between years 1997-2016. I have had some administration tasks too.

Were you been involved in the collection of information for AACSB accreditation prior to the launch of the Oulu Business School Intellectual Contribution System?

SU1: Yes.

SU2: Yes

If you were, can you briefly describe the previous method for collecting information about intellectual contributions?

SU1 and SU2: We created an Excel spreadsheet (as well as word form) to which each user filled their information. After that they send spreadsheet (as well word form) back to me and I summarized each user sheets in Excel to have a summarized reports of the school.

In your opinion, what were the major problems that the Oulu Business School Intellectual Contribution System needed to address?

SU1 and SU2: The older data collection system demanded too much manual work in each year by the super user(s) and it was difficult to run different reports from the system. Data was not stored in a proper way.

Consider the original problems that the Oulu Business School Intellectual Contribution System was designed to address. Do you feel that the system has met your expectations in the solutions that it offers?

SU1 and SU2: The system must be enough simple to use and visually clear for the user to operate in the system. The user must also have possibility to see historical information in a summarized view. The user should have possibility to edit or delete their contributions. The super user must be able to easy run different reports by the selected time period or year. The super user must also have possibility to easy check detailed information of different users’ contributions. The current system meets our expectations.

Do you feel that the Oulu Business School Intellectual Contribution System is more efficient or less efficient than the previous method of collecting information? Can you offer any particular examples for either case?

SU1 and SU2: It is now much more efficient. Users can add their achievements/contributions into the database anytime. In the previous system the data was collected once per year. The super user can easily run different reports. In the previous system taking reports demand too much manual work by the user in Excel.
Has the Oulu Business School Intellectual Contribution System meet your expectations for an Oulu Business School product?

SU1 and SU2: So far yes.

Overall, are you satisfied development of the Oulu Business School Intellectual Contribution System?

SU1 and SU2: We are very satisfied because the development work was started from zero stage and now we have a system which works well.

Overall, are you satisfied with the Oulu Business School Intellectual Contribution System?

SU1 and SU2: Yes

Do you have any other comments regarding the OBSIC system or its development?

SU2 and SU1: We hope that in the future evaluations of bachelor and master theses could be added to/done in the system. Now each lecturer fills evaluation forms and saves them in their own computers and delivers only paper versions to the administration office. This means that at the moment detail evaluation forms are in electronic form only in each lecturer’s own computer.

Every year we collect original evaluations forms from lecturers to summarize their information. Even if lecturers deliver these forms for us in electronic form, it takes time to edit them. One reason why we collect this information is that based on the evaluations of master and bachelor theses we can evaluate how well our students receive learning goals at the department and business school level. This analysis is an important part of the assurance of learning (AOL) process in Oulu Business School.
Appendix 2 - AACSBS Contribution Classification

ACADEMIC CONTRIBUTIONS

- Acquiring Competitive Research Funding
- Book Editor
- International Peer Reviewed Journal Article
- Invited Speaker/Presentation in Academic Seminars / Conferences / Meetings
- Invited Speaker/Presentation in Professional Seminars / Conferences / Meetings
- Journal Chief Editor
- Opponent of Doctoral Dissertation
- Position of Trust in High Level Academic Body / Company
- Pre-examiner of Doctoral Dissertation
- Peer Reviewed Paper Presentation
- Peer Reviewed Proceeding
- Published Case
- Referee / Associate Editor of Peer Reviewed Journal
- Research Monograph
- Statement for Professor and Adjunct Professor Appointments
- Textbook
- Textbook Chapter
- Thesis Supervision

PROFESSIONAL AND BUSINESS LIFE CONTRIBUTIONS

- Article in Professional or Popular Publications
- Chairing or Membership of the Board of a Large Company/Organisation
- Full-time Practitioner Job in Area of Teaching Expertise
- Position of Trust in Company / Professional Body
- Professional Report / Publication
- Working as a Private Consultant

TEACHING AND ADMINISTRATION DUTIES

- Course Teaching
- Dean's Duties
- Dean of Education's Duties
- Development of a New Course
- Director of Department's Duties
- Education Committee / Teaching Development Group Membership
- Management of Education at School or Program Level
- Pedagogical Training
- Tutor Teacher / International Coordinator Responsibilities
- Submitted Journal Articles