System Customisation under Multiview Framework

Analysis and design for a web information system in a small and medium-sized enterprise

Yunchen Sun
yunchen.sun@yahoo.com

Supervisor: Steve McKeever

Master's programme in Information Systems
Department of Informatics and Media
Uppsala University
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Abstract

Small and Medium-sized Enterprises (SME) benefit from IT services. A Web Information System (WIS) is one of the best options available to manage business. SMEs in the service industry often have special business models and needs, which the standard WIS will not support. Therefore, system customisation must be conducted to reflect the changes. A WIS Development Methodology (WISDM) under Multiview framework is implemented to conduct the customisation process. In this research, a single study was conducted with a local SME called BUK AB and the design and creation research strategy was applied to tackle the problem situation. Five problems associated with the system were first identified, namely version difference, system incapability, functionality incompleteness, system-usage inadequacy and service inefficiency. Then, several customisation suggestions were proposed by applying Multiview framework, using illustrations from a prototype and other WISs to deal with the situation. It was also concluded that throughout the process system customisations can be achieved mainly through improving functionalities and User Interface (UI).

Keywords: system customisation, Multiview framework, system design, system analysis.
Acknowledgement

Many thanks to my supervisor Steve McKeever, staff at BUK AB, Anneli Edman, my family and my friends.
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1. Introduction

IT services help small and medium-sized enterprises excel in their business. However, with the increasing use of web information systems, serious issues appear due to inadequate customisation. This study will try to examine this situation and provide suggestions to the first stages of system customisation by applying Multiview framework. In this chapter, a brief background overview about the thesis is presented. Three research questions are then proposed together with the target audience and thesis delimitation. The overall structure of the thesis is also presented at the end.

1.1 Background

A Web-Based Information System (WBIS) or a Web Information System (WIS) is a system that benefits from internet access and web technologies. It delivers information and services to clients and even interact with other kinds of applications or systems. One of the biggest advantages is the availability. It is available on multiple devices and platforms as long as there are broadband connections. It is very flexible and has a relatively low cost. It often has a cloud database and does not require the client to set up a local one. It is also ready to deploy and easy to migrate from the previous systems. A WIS is able to communicate with other systems by using APIs as well. In terms of development methodology, a WIS Development Method (WISDM) under Multiview framework is a natural choice for many web-based applications. As an improvement to the traditional system development technology, it combines development technology of websites with database design and program design.

Some of the most popular web information systems in Sweden are for instance Fortnox, Xdesk, Visma, Mobigo and KBBS. There are two different types of WISs in general. The first kind offers a rather comprehensive system, which covers a majority of business functions. For example, Fortnox offers flexible business programs, and they are sold by functions. The most popular functions are accounting, billing, direct debiting, and ordering. Some providers focus on only one function on the other hand. Mobigo, for instance focuses more on the mobile field service management. KBBS
offers the booking system. In most cases they also provide the possibility to be connected to modules by the same or other providers.

Due to the scale of Small and Medium-sized Enterprises (SMEs), WIS is one of the most effective and efficient ways of managing business. Many of the WISs promote themselves as the best options for SMEs. Some basic functions SMEs need are accounting, inventory management and security, payment processing and communication (Ingram 2016).

When describing a small business, the EU looks into the following factors: staff headcount and either turnover or balance sheet total. The definition of a small business is a business that has less than 50 staff and the turnover or the balance sheet total should be less than 10 million Euros (EU 2012).

SMEs contribute to the world’s economy substantially. According to the European Union (EU 2012), SMEs make up of 90% of all the businesses, account for around 50% of the GDP and create many job opportunities. Some policies are made to encourage entrepreneurship. The Small Business Act (SBA) for instance is a framework to promote entrepreneurship and develop a better business environment for SMEs in Europe.

The figures of SMEs in Sweden are overwhelming. According to Company Database from Statistics Sweden (SCB:s Företagsdatabas 2015), 99,83% of all the companies are SMEs with fewer than 200 employees (Table 1). Among those SMEs, one-man business consists of 73,45% of all the businesses.

<table>
<thead>
<tr>
<th>Employed</th>
<th>Percentage</th>
<th>Numbers of Business</th>
</tr>
</thead>
<tbody>
<tr>
<td>One-Man Business</td>
<td>0</td>
<td>73,45%</td>
</tr>
<tr>
<td>Micro Business</td>
<td>1-9</td>
<td>22,78%</td>
</tr>
<tr>
<td>Small Medium Business</td>
<td>10-199</td>
<td>3,60%</td>
</tr>
<tr>
<td>Big Business</td>
<td>200+</td>
<td>0,17%</td>
</tr>
<tr>
<td>Total</td>
<td>0-200+</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 1. Percentage and Numbers of Business per Size Class (2015)
SMEs benefit from IT technologies. Websites, emails and IT systems like ERP (Enterprise Resource Planning) are the most common choices. However, the implementation of a standardized information system does not always go smoothly. Since the system provider offers the same solutions to the clients, some customisations must be done to satisfy specific business needs and improve the user experience. Especially when the system does not support the business model, serious problem will occur and even lead to financial loss. (Haines 2009)

In the academic world, IT system for SMEs is a popular research subject. Previous research mostly covers the topic of ERP system customisations and reasons behind customisation (Buonanno 2005, Haines 2009, Hicks et.al. 1999 and Mathrani & Viehland 2009). In general, it can be concluded that the customisation process will repeat the cycle of system development partly, which includes key stages like system analysis and design, implementation, testing and maintenance. Certain practices have also been discovered to make the customisation go as smoothly as possible. However, due to the difference within IT systems, the result cannot be necessarily applied to WISs. Moreover, the research focus has never been shifted to WISs. The customisation methods differ from system providers and the degree of customisation is not the same as other systems (Zach & Erik 2012).

1.2 Research Questions

The main goal of the study is to explore the first stage of customisation, namely system analysis and design for WIS under Multiview framework. In this study three research questions will be associated with an information system and an SME. It is a case study in cooperation with BUK AB and the field service management system it is using. The questions are listed below:

- What kind of IT systems does a SME in the service industry need?
- Are there any problems with the IT systems?
- How can system customisation under Multiview framework deal with the problems?
WISDM under Multiview framework is chosen as the main theoretical background to investigate the research questions. As an improvement to the traditional system development technology, it incorporates multiple perspectives when examining the problem situation, i.e. technical, organisational and personal (Vidgen 2002). Multiview framework combines development technology of websites with design technology for programmes and databases. After applying the methods matrix, namely organisational analysis, information analysis, work design, technical design and HCI design, artefacts are generated to tackle the problem situation and provide optimal solutions.

1.3 Target Audience

This study can be viewed from different perspectives. It has some technical documents to translate business models. It has some interviews to reflect the business needs. It also has concrete suggestions to improve the system. Therefore, the key audience for this thesis could be:

1. Owner of SME: bad implementations of the system will lead to severe consequences. This study reminds them to examine their needs for information systems and select the most suitable ones based on their business needs.
2. IT consult: as an intermediate between business and system provider, they need to realise how to communicate with both parties. They should be also able to transfer the business model and other requirements into tangible parts in the system.
3. System provider: it is not always easy to understand the clients and keep them satisfied, however it is very important to do so. Learning from the clients and making constant improvements will make a difference.

1.4 Delimitation

System customisation for a WIS is a complicated project and needs participants from all parties. In this study, since the author does not have the access to the original codes from WIS in question, the scope will be narrowed down to only the system
analysis and design of the potential system and give suggestions to both the owner of SME and the system provider.

1.5 Thesis Structure

There are six chapters in total in this thesis.

In Chapter 2, a literature review has been conducted to explore how previous research has been covering the topic in question, which leads to the topic of this study and the gaps between literature.

In Chapter 3, the methodology of the thesis is introduced and the reasons why methods are chosen are discussed. In addition, some models of the research process and the data analysis are also illustrated.

The context of the case study will be presented in Chapter 4. The SME BUK AB is introduced and the problems are discussed after a brief examination and initial analysis to the situation.

The results from Chapter 5 are generated and presented under the Multiview Framework and some improvement suggestions are provided to tackle the problem situation and guide the customisation process.

Finally, Chapter 6 concludes the whole thesis, discusses the results, answers the research questions and indicates future research directions.
2. Literature Review

Lots of previous studies have been conducted in the field. Some of them are directly related to the research interests while some are not. In this chapter an overview for IT usage in SME is presented first. The Multiview framework is introduced as the theoretical base of the thesis and other main concepts like WIS, system modelling and system customisation are also explained. However, some gaps between literature have been discovered, which indicate the possibility to investigate further into certain domains.

2.1 IT in SME

SMEs are well-known for their creativity and quick adaption, therefore there is no surprise that many of them cannot survive without IT services. It is wildly believed that by using proper technologies, it will make the enterprise stronger and even compete with much bigger organisations.

E-Business is a term to describe business with the aid of IT technology. SMEs can benefit from using technologies like blogging and building a virtual team. Blogging for instance is getting popular among SMEs, which is also an alternative instead of traditional marketing tools. It has the advantage of low cost and minimal effort. It also has the potential to reach a broader audience. It is concluded that SMEs fulfil some marketing strategies through blogging, such as branding, niche marketing, promoting and so on, even though it could not be determined to be efficient or not (Chua, Deans & Parker, 2009).

The concept of a virtual team is another interesting topic for e-Business. On the contrary to a traditional team, a virtual one uses internet, works from different locations, and brings the team collaboration into a new level. The key of a virtual team is that it is not required to meet in person to conduct team activities. Matlay and Martin (2009) looked into a team of European e-Entrepreneurs on their collaborative project in the tourism industry. In order to accomplish this task, several adoptions have been made
to achieve standardisation of business functions such as accounting, marketing and managing.

Information systems are the key to success for many SMEs. Nowduri (2012) emphasised the importance of information systems to SMEs. There should be three levels for the modern design of systems, namely organisational level, application level and user level. Mathran and Viehland (2009) investigated the usage of ERP in New Zealand and they concluded that SMEs could benefit a lot from the system, including improvement of business process and information flow, despite the fact that the investment could be huge. It is however tricky to select the right system. Wolf (2010) summarized some key evaluations when ordering a new system: a feature booklet, reference list and demonstration program. Some criteria for example are ease of use, flexibility, access to information, integration and support service.

### 2.2 Web Information System

Information systems have existed for decades and many organisations are heavily dependent on them. The main functions behind information system are to store, manage and process data. The data could be generated from customers, suppliers, employees and other sources. There are different definitions about information system. The main focus however is to determine if the information system could be considered as a software system; if the system supports organisations, people or even other systems; and if the system needs to be based on a business process. According to Alter (2002) and van det Aalst & Stahl (2011), it is defined that “an information system is a software system to capture, transmit, store, retrieve, manipulate or display information, thereby supporting people, organisations or other software systems.”

Information systems could be classified by different criteria. One high-level classification presented by van det Aalst and Stahl (2011) includes three types of systems, i.e. personal information systems, enterprise information systems and public information systems. An Enterprise Resource Planning (ERP) system is one of the most important examples for enterprise information systems, which supports the key business processes in the organisation, like marketing, management, accounting,
sales, human resource management and so on. Since ERP is a complex system, organisations can choose to purchase and customise afterwards, or they can build one by selecting different components. Not all the functions provided are used in most cases. To solve this problem, one famous software vendor SAP for example offers individual configurations to different industries to fit the business better. New web technologies like cloud services have been influencing information systems. McCrea (2011) concluded that the interest for cloud platform for ERP system has been increasing throughout the years. Out of 200 manufacturers, 25 percent of the respondents expressed their positive attitude towards SaaS software implementation.

Web information system (WIS) is getting more and more attention from both users and developers. The technology behind shifts the focus from a set of HTML pages to a more manageable WIS. A WIS evolved from systems with intensive hypermedia to database-driven systems that have close connections to the users. Gnaho (2001) summarized that a WIS is an information system that provides the access to data and interactive services through the Web. In Zheng (2008)’s definition, a web information system focuses on the utilization of web technologies like cloud computing and SaaS. Some typical WISs are e-business applications, Intranet systems, and some CRM systems (Zheng 2008).

A web IS development is different than a traditional one. It involves both web application technologies (like user interface) and IS development (database and program design) (Howcroft & Carroll 2000). Vidgen (2002) followed a two-year’s project on implementing an e-Commerce application for a SME in the UK. Some difference occurred when compared to a traditional IS development project. For example, in terms of strategy, traditional IS projects are more abstract and sometimes even not being addressed, while web projects are tangible and more related to the business goals. In terms of user, in most cases an internet project is about customers, thus they do not need to be trained to use the system and their needs could be understood by marketing and sales methods. On the contrary, a traditional one focuses on employees, they need trainings to understand the system and it is almost a requirement to use it. Finally, in terms of design, in general a traditional project focuses more on the functionality and internal design while a web one will be on the visual artefact and a satisfying UI.
2.3 WISDM under Multiview Framework

A WIS Development Methodology (WISDM) has a set of established practices to produce web applications, mainly websites and web systems. A Multiview framework has been applied as an improvement to the traditional approaches. It was often overemphasised on the engineering side of IS development, especially on the design and construction, instead of social and contextual aspects of the development phrase. Avison and Wood-Harper (1990) thus proposed a Multiview Framework that involved a sociotechnical solution to the problem. In the framework three tiers are structured, namely general framework, local methodology and methods or techniques. The framework is used to describe the situation when engineering-based approaches collide with the sociotechnical ones.

As shown in the Figure 2.1, the change agents are in most cases IS developers, who engage in the process of examining the problem scenario (situation) and accomplish the tasks. The agents do not use a single perspective to tackle the problem situation. Instead, Mitroff and Linstone (1993) argued that different disciplines need to be taken in consideration when dealing with complex situations, especially the following three perspectives: the technical (analysis) perspective, the organisational (societal) perspective (O) and the personal (individual) perspective. The latter two are the critical links between the first perspective and the actual action the agents are going to take.

According to Watson and Wood-Harper (1995), the framework is seen as a metaphor for some specific situations rather than real life activities in the world. The WISDM under Multiview framework also uses the old four quadrants of the methods matrix, namely organisational analysis, information analysis, work design, and technical design, with a new aspect HCI (Human-Computer Interaction). The five quadrants are presented with the outcomes and highlight different aspects in the development phrase as well. These methods are often used in system analysis and design phrase to solve problems from a blended approach, involving system developers, managers and personnel.
Models are critical to translate intangible business needs into tangible requirements and are often used under Multiview Framework. Rohleder, Davis and Günther (2005) took advantage of the Unified Modelling Language (UML) for customisation. Diagrams helped when designing the customised system. Liaskos et al. (2011) implemented the goal models when making customisations. Goal models are made of AND/OR goal decomposition graphs to define the high-level goals from stakeholders. Suryadi et al. (2014) investigated the SMEs in Indonesia and applied Object-Oriented Analysis and Design (OOAD) methods to an accounting system. In the process, a cost report, a use case diagram, class diagram, navigation diagram has been generated to aid the analysis. Gardner et al. (2012) improved a database structure to a health information system by using a prototype, after making changes to the current system.

In the methods matrix, each quadrant has a special goal. Organisational analysis is associated with value creation and creative thinking (Vidgen 2002). Some approaches like Soft Systems Methodology (SSM), e-Commerce models or a combination of soft and hard methods are implemented. For information analysis, UML is a tool to specify requirements. Use cases can be generated to describe the functionality of the system and diagrams can aid the devolvement phrase. Work design and technical design when standing from a sociotechnical perspective, apply ETHICS approach. ETHICS (Effective Technical and Human Implementation of Computer-based Systems) aims
to achieve a balance between job satisfaction and the efficiency objectives (Mumford 1995). Work design also represents stakeholders’ interests. Technical design solves the actual problem and defines the physical requirements for software models, such as the database and user interface. HCI concerns more with design style, and how to achieve a higher satisfaction through user interface design. Vidgen (2002) concluded annotations for different aspects, such as: organisational analysis with envisaging, information analysis with rationalizing, work design with championing, technical design with engineering and HCI with anesthetizing. Depending on the projects, not all of the five aspects are needed in order to reach a solution. Nevertheless, there is no doubt that a successful WIS project needs all five of the web IS development methods.

2.4 System Customisation

Similar to developing a regular information system, life cycle models can also be implemented for system customisation. van det Aalst and Stahl (2011) concluded from several real system developments and summarized two development processes for information system, namely implementation and customisation. In the customisation cycle, there are seven main phases, namely requirements, (re)design, design analysis, configuration, execution, monitoring and runtime analysis, as indicated in Figure 2.2 below. In the industry, there are many ways to customise a system depending on the software vendors. One way of implementing customisations is also to start with system analysis and design (Panorama 2009).

![Figure 2.2 System Customisation Cycle (Edited) (adapted from van det Aalst & Stahl 2011)](image)
Most systems are made to meet the general needs from organisations, which in some cases will not meet some specific requirements. System customisation can deal with this issue to some extent. There are different aspects of customisation and many approaches have been made towards customisation. Hicks et.al. (1999) introduced a metadata model based approach to provide independence of each data object. Liaskos et.al. (2011) explored a goal-driven technique to address some behavioural aspects of the system. The use of goal models translates the user requirements, which enables a high-level design. Peng (2011) improved the hospital system performance by optimizing the database structure.

For SMEs, it is critical to either change business process to fit the system, or to apply certain changes to the system instead. A business process is about coordinated activities which are performed in an organisation to reach certain business goals. It is also possible to interact with business processes from other organisations. Generally speaking, the activities can be summarized and have specific orders (van det Aalst & Stahl 2011).

Buonanno et al. (2005) pointed out that for SMEs there are two options, either system customisation or organisational adaptation. Organisational adaptation implies many changes towards the existing processes and the success rate is thus not ideal. Quiescenti et al. (2006) argued that because some competitive edges for SMEs lie in their unique business processes, changes and adaptions could potentially even harm their existence. Therefore, it is becoming a common practice to customise the system and find the best fit between the system and the business processes.

Many studies have been done to investigate why ERP system needs customisation. Kimberling (2009) concluded three reasons why an ERP customisation could be controversial, namely the increased complexity, the risk to undermine built-in practices, and the mismatch with requirements. Zach and Munkvold (2012) concluded some reason for ERP system customisation for SMEs. Prior to “going-live”, they are affected by resistance to change, unique business processes, functional misfit and ownership type and motivation for implementation. After “going-live”, it is important to take into consideration of the stage of growth and the maturity of ERP systems.
The goal of customisation is to fill the gap between ERP system functionality and the business process (Luo and Strong 2004). Rothenberger and Srite (2009) improved a framework on the ERP modification options, namely configuration or selection, bolt-ons and system change. It was pointed out that the customisation rate for ERP systems were relatively high, and only around 25 percent of the investigated organisations implemented little or no customisation at all (Kimberling 2009).

<table>
<thead>
<tr>
<th>ERP Software Vendors</th>
<th>Heavy</th>
<th>Moderate</th>
<th>Vanilla</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAP</td>
<td>38,40%</td>
<td>40,60%</td>
<td>21,00%</td>
</tr>
<tr>
<td>Oracle EBS</td>
<td>34,40%</td>
<td>40,00%</td>
<td>25,60%</td>
</tr>
<tr>
<td>Microsoft Dynamics</td>
<td>32,80%</td>
<td>42,20%</td>
<td>25,00%</td>
</tr>
<tr>
<td>Tier II ERP Software Packages</td>
<td>23,50%</td>
<td>48,10%</td>
<td>28,40%</td>
</tr>
</tbody>
</table>

Table 2.1 ERP Software Vendors Average Rate of Customisation (Kimberling 2009)

ERP customisation is influenced by different factors. Business units have different levels of ERP module customisation. It was observed that the higher strategic importance the business unit is, the higher degree of customisation it has (Haines 2012). Haines (2012) also concluded an influence model on ERP customisation. Four main categories of the influence factors were included, namely institution, strategy, system and project.

Another factor that influences customisation is how flexible the system itself is. The more different variants system provider incorporates in the system, the easier it is to adjust with configuration or customisation. In order to achieve certain level of customisation, there are some approaches related to models. Jiang, Zhang and Liu (2010) proposed a model-driven approach where it is done on three layers, user interface, business process, and data layer. By keeping user specific models each user could access to their model separately.

System customisation is not easy to conduct. Organisational risks may occur during the process and lead to a failure. An Organisation Risk Evaluation framework has been proposed to measure risks occurred under customisation (Agrawal, Finnie & Krishnan,
The framework has a two level risk metrics, namely organisational and project level. Changes like technology, size, requirements, personnel among other measurements are combined to calculate the risk. Two factors (priority and dependencies) are taken into consideration when the risks are being transferred between two levels. Two special organisational risk factors internal and external context are also included when examining ERP systems.

When building web ERP systems in Clouds or using SaaS (Software as a Service) technology, the cost will be reduced, the implementation is relatively easy, and the requirement for IT department or personnel is minimal. However, challenges will occur especially when it comes to customisation. Mijac, Picek and Stapic (2013) examined the possibilities of customisation for Cloud ERP systems. Because the systems offered are usually based on standard workflow, they do not support businesses with unique processes. Ried, Kisker and Matzke (2010) argued that customisation could potentially ruin the implementation and even application packages. They also claimed that those vendors who convince the customers to adapt to their business logic are successful. Saeed, Juell-Skielse and Uppström (2012) considered that there are more technical barriers when conducting ERP adoption in cloud environment than on premise.

On the other hand, according to Jiang, Zhang and Liu (2010), some customisations can be achieved by pre-determined parameter configurations. The changes in configuration will not be reflected in the source code, however features like changing data fields and modifying UI could be achieved (Sun et al. 2008). It will also reduce the cost to hire a third party to conduct the customisation and change the source codes.

Customisation does not end after the implementation. Maintenance is also an important issue to consider in this process. Koch and Mitteregger (2014) examined the changes to maintenance after customisation for ERP systems. The result showed that the more customisations have been done, the more support efforts provider has to offer, especially the help desk. The scope of the system also plays an important role. Compared to the implementation, the effort for customisation is below 14 hours according to 75% of the sample group.
2.5 Gaps in the literature

It could be summarized that IT is the backbone of many SMEs. It makes marketing cheaper, management easier and reaching more potential customers. It is even possible to organise a virtual team thanks to the technology. A WIS is among one of the most popular choices. It is available on multiple platforms, very flexible and has a relatively low cost. The development of a WIS under Multiview framework is slightly different to a traditional IS with the introduction to a new HCI perspective. System customisation is an option to make the system fit better in a certain organisation. It is strongly motivated why a SME should conduct an ERP customisation to maintain its unique business process despite there are certain organisational risks. With a WIS, it is possible to achieve some changes in features. However, it is more difficult to make a comprehensive customisation without the support of the developers. To conduct a customisation, there are life cycles to follow. It is necessary to start with the basic system analysis and design to translate the business needs into concrete tangible objects. Modelling technology like UML is commonly used to visualize the outcome.

In general, studies have been conducted about system customisation. Most of the studies focus on ERP in SMEs instead of WIS as a whole. Moreover, the reasons for customisation while using WIS and the aspects behind need to be investigated. It is also observed that there is more research about what obstacles might be, instead of how to implement customisation, or what will happen in the customisation process. On the other hand, Multiview framework as a tool has been mostly applied to the development process of a WIS instead of customisation. Since the analysis and design stage is critical to customisation, Multiview framework will provide a comprehensive solution to the problem situation. How using Multiview framework will benefit customisation process is a topic that needs to be covered.

It is understandable that vendors have different customisation methods in the industry. However, this thesis tries to explore the possibility to conclude some of the standards processes for WIS system customisation using the Multiview framework from Vidgen (2002). From a life cycle point of view, this thesis will focus especially on the beginning phrase of customisation, namely system design and analysis (van det Aalst & Stahl 2011).
3. **Methodology**

This chapter presents how the research was done. In this qualitative study, a combined research strategy has been applied, namely a single case study and a design and creation method. In order to generate data, interviews and documents have been used. A qualitative data analysis has been chosen as the main analysis method, which includes an initial analysis and problem description before conducting the main analysis and reaching the customisation suggestions.

3.1 **Case Study**

A single case study is a study in depth regarding a particular situation instead of a broad subject. It has been used especially in social science, psychology and other related disciplines. Oates (2006) has concluded some other characterizes such as natural setting, and multiple sources and methods. It is often argued if a narrow example could reflect the whole picture, however the result from a case study provides more detailed responses from just a general survey. It is also easier to obtain first-hand information from the participants and get to know their daily routines and work. To understand the situation better and to gather information in depth, the study is holistic. This means that there are different factors and the relationship between those factors are interesting to the research.

This case study is an exploratory study because there are few literatures about this topic. It is interesting to find out the IT needs of a SME and their current systems, including the problems they have encountered and some potential solutions to them. In addition, during the literature reviews, it is found that similar research conducted has also favoured case study than other research strategies. The chosen SME BUK AB is in the service industry, with a focus on objects like fire protection equipment. Most of the SME are in the same industry and share similar business models. Therefore, the case itself makes a typical instance and can be generalized to other situations.
In terms of gathering data, interviews are the main methods during the case study. It is important to include different perspectives and opinions from different participants so it is highly encouraged to gather as many participants as possible.

### 3.2 Design and Creation

In design and creation research strategy, artefacts are created to represent new IT products, including models, constructs, instantiations and methods (Oates 2006). In this study models and instantiations are the main focuses from the artefacts generated. Models are constructed to illustrate certain situations. Instantiations are for example working or partially working systems to examine a method or technique. Design and creation is also considered “the ultimate goal of computer science and programming” to create new artefacts (Wirth 2002). It is possible to conduct design and creation solely as a research strategy, however when applied together with another strategy (in this study a case study), it applies empirical research into the real world scenario. The reason behind the chosen method is to solve a problem. Some steps are also suggested to ease the process (Oates 2006), such as awareness, suggestion, development, evaluation and conclusion. Design and creation needs a software system development method as a backbone and Vidgen (2002)’s Multiview framework of Web Information System Development Methodology (WISDM) was implemented in this study. It is one of the most developed and most popular development methodology for WIS and it still applies to many cases (Oates 2006).

According to Vidgen (2002)’s Multiview framework of WISDM, namely organisational analysis, information analysis, work design, technical design, and HCI. For each segment there are specific outcomes. Organisational analysis focuses on producing the business model and how the organisation can generate value by following the SSM approach. Information analysis for using mark-up language for example UML to create class diagrams. Work design concerns more about the balance between job satisfaction and objectives of the organisation by conducting questionnaires. Technical design is about software models and for example how database is connected to the web and HCI simplifies the interaction and can be inspired by other exemplars.
Interviews and documents are both the main methods for collecting data. However, they do not necessarily happen at the same time. Some documents are created and examined after the interviews. In this way more valuable data can be obtained.

### 3.3 Data Generation and Analysis

In the single case study interviews are conducted to gather insight of the issue. By using interviews, a researcher can obtain some information in detail, observe emotions, experiences that cannot be easily defined by a questionnaire, and investigate more sensitive issues (Oates 2006). Interviews in this study were conducted as semi-structured interviews. One of the advantages of semi-structured interviews is to allow interviewees to express their feelings instead of checking pre-set assumptions. The interviews were conducted during two meeting sessions. The participants are listed with their respective positions below by a participant code (P1 - P2). Since it is a small business with few employees, these participants are the only frequent users of the IT systems.

P1: Co-Owner, Technician

P2: Co-Owner, Technician and Trainer
Documents are another source of data in this study and both found documents and researcher-generated documents are used. Found documents include the company website, product and service descriptions. Researcher-generated documents include the models and diagrams generated under the design and creation process. Generating documents was an iterative process and documents were constantly revised based on the feedback.

Qualitative data analysis is applied after the initial data generation, as illustrated in the data analysis model in Figure 3.1. The interviews were first recorded and transcribed. An initial analysis was conducted to understand the business model and process better. Documents on the other hand were partly generated after the interviews and from the design and creation, which were used as an aid to the analysis. Problems from the existing systems were described after the analysis. After that, the situation led to the WIS methods matrix from the Multiview framework and customisation suggestions were proposed according to the problems.

Figure 3.1 Data Analysis Model
3.4 Summary

By combining a single case study and design and creation research strategy, this study has four stages in the research process, namely project planning and data collection, data analysis and conclusion (Figure 3.2). In the first stage the research questions and goals are defined by the aid of literature review, which also provides a theoretical background to support the entire research, i.e. WISDM under Multiview framework and how it is conducted. For the second stage, data is collected through interviews and documents, which are coded and lead to a qualitative analysis. As a result, some diagrams and models are generated to reach a problem description after the initial analysis. An overview of the IT usage of the company is conducted to answer the first research question. At the same time business models and processes are examined and the problems from using IT services are exposed. The problems are divided into five categories and two potential aspects behind customisation are also concluded, which lead to the answer of the second research question. The situation is investigated further and Multiview framework is applied to deal with the problems identified. After each stage in the framework, various artefacts are generated to support the design and analysis process. Furthermore, the customisation suggestions are given based on those artefacts. A simple prototype is also made for demonstration purposes to further illustrate how the potential customised system should look like. The application process of Multiview framework is the answer to the third research question. Finally, a conclusion and discussion session are made based on the customisation suggestions to the problem situation.

Figure 3.2 Research Process
4. The Case - BUK AB

The research process was introduced in the previous chapter. In the section, some analysis has been done to examine the overall situation. The case was conducted with BUK AB. The co-owners contacted the Department of Informatics and Media at Uppsala University to seek for help with the current systems they used. An overview from the company is presented first. Next, the IT needs are examined to answer the first research question. Some problems from using IT services are discovered through an initial analysis about the business model and process. They are then classified into different categories to answer the second research question. All the artefacts generated in the chapter are based on the interviews and found documents as described in the previous methodology section. In addition, they are used in the next chapter for further analysis in order to find solutions to the problems.

4.1 About BUK AB

BUK AB (Brandskydd och Utbildningskonsult AB) is a local fire protection and training consultancy in Uppsala, Sweden. It offers cost effective services and ensures fire prevention and safety in properties. Its main clients are real estates, companies, organisations and enterprises. It assists with the fire prevention both in the companies and the buildings, and work methodically and structurally. Moreover, it has a comprehensive portfolio of services, sales, consultancy and training in all necessary fire protection areas. In addition, it offers sponsorship to local sports teams. Currently there are three owners and two employees.

BUK AB offers a range of services in the fire protection industry. Its services include:

- Fire protection inspection, description, documentation, inventory.
- Planning for emergency.
- Planning for flammable materials.
- Risk analysis for fire and flammable materials.
- Expert certificate on fire.
- Systematic fire protection work.
Maintenance.
Planning for strategy, action and evacuation.

Fire prevention is not only about the technical equipment and solutions, but the knowledge and the awareness are also very important. BUK AB offers training in fire prevention, first aid, L-ABC (Deadly situation: Breathing, Bleeding, Shock or Circulatory Collapse), CPR and so on. It customises the course design according to the clients’ requirements. It organises trainings in kindergartens, elderly homes, industrial buildings, healthcare centres, bus and taxi companies, and SMEs.

Maintenance plays a very important role in fire safety. Equipment needs to be checked regularly to make sure they are in good condition. BUA AB offer maintenance to the following equipment:

- Fire extinguisher.
- Emergency lighting.
- Smoke vent.
- Ansulex kitchen facilities.
- SBA systematic fire prevention.

BUK AB provides the overview of fire protection. It is in connection with the annual maintenance and is compiled in the protocol. The status of equipment is checked and deficiencies are noted. Some key areas are: the instalments of fire protection equipment, fire risks, and status of systematic fire protection work.

### 4.2 IT Needs

BUK AB has a website built by WordPress. The website has nine tabs in total, and each tab serves at least one function:

- **Home tab:** to introduce the company itself, its impact on the environment and its quality assurance, its current campaign, its partners and its videos and photos.
- **News tab:** to display what is new with the company.
Services tab: to describe which services they offer.
Trainings tab: to display the course calendar, to describe the trainings and to book the courses.
Maintenance tab: to submit a maintenance request or register a fault report.
Products tab: to describe which products they offer and display some information flyers.
References tab: to show some references.
Documents tab: to display the campaign, product and safety information flyers.
Contact tab: to show the contact details from the company.

![BUKAB Website Screenshot](image)

**Figure 4.1 Screenshot from BUK AB Website**

Before introducing to a formal information system, BUK AB used Excel during its early years of business. Excel was efficient in the beginning and did not cost anything. Because of the expansion of the business, BUK AB developed the need for a real system. The staff purchased a web-based financial system, and a field service management system with two versions, one for desktop and one for mobile devices. Two systems are connected and communicate with each other via API.

The financial system consists of two parts, namely the accounting and the billing functions. All the bookkeeping and money management are handled by the accounting system, and the billing system creates invoices.
The field service management system keeps tracks of the clients, organises service reports and agreements, and deals with the orders and the objects. Field service (especially maintenance) is a big part of the working routines. Objects need to be checked regularly after a specific time period. When objects like fire alarms and fire extinguishers are ready to be checked, they will be shown in the system and remind the technician. In other case if the client files a fault report, the technician will receive an email notification and have to manually register into the system. The technician then needs to visit the location and conduct maintenance. The client needs to sign on the agreement after approving the service. Afterwards, the technician will update the status in the system and prepare invoices by the financial system and send them to the client via emails.

4.3 Initial Analysis

In order to understand the business better, a detailed business model and process analysis has been conducted based on the transcription from the interview and the documents. As a result, a Business Model Canvas is created first to have an overview of BUK AB (Table 4.1). It is a strategic management tool to develop or document existing business models. By defining some key elements such as business activities, value proposition, customer relationships, and customer segments, the canvas explores the conceptualization of business. The key activities identified are consulting/training, marketing, selling products and maintaining products. The value is delivered to the customers by selling fire equipment, maintaining, providing consultancy with regards to fire protection, building fire prevention system and teaching fire protection and first-aid. Moreover, BUK AB builds its relationship with customers through long-term contracts, personal assistance, and maintenance. Lastly, the customers are mainly from local companies, and people or organisations who use the fire equipment.
Table 4.1 Business Model Canvas for BUK AB
A good process management will lead to business success. Business Process Management (BPM) is to model, automate, manage and optimize the business process to achieve efficiency, effectiveness and agility during the entire lifecycle. Business Process Modelling Notation (BPMN) is a mature tool to translate business process into models. From Figures 4.2 to 4.5, process models are made for key activities like ordering, training, consulting and maintaining. In the process models, the main actors and processes are described from a different perspective. Since many activities involve IT services to some extent, they indicate the aspects that can lead to potential problem. For example, when maintaining multiple objects, the process does not allow optimizing the orders instead it will be carried out by the time it reaches the company.

Figure 4.2 Process Model: Ordering
Figure 4.3 Process Model: Training

Figure 4.4 Process Model: Consulting
4.4 Problem Description

After gaining an overview of the business, the research proceeded to study the results from the initial analysis. Even though there were many positive feedbacks from using the current IT systems, major issues were spoken out directly from two participants during the interviews. Some minor issues also occurred from time to time, but in most cases the help desk will deal with the issues. It is those major issues that have been affecting their business process especially using the field service management system, which are listed in Table 4.2 according to their problem category.
Table 4.2 Problems from IT services and business

<table>
<thead>
<tr>
<th>Problem</th>
<th>No.</th>
<th>Description</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Version Difference</td>
<td>1</td>
<td>WIS for field service has two versions and they are too different.</td>
<td>High</td>
</tr>
<tr>
<td>System Incapability</td>
<td>2</td>
<td>The system is client-based and thus cannot handle from an object level.</td>
<td>High</td>
</tr>
<tr>
<td>Functionality Incompleteness</td>
<td>3, 4</td>
<td>Certain functionalities need a rework. The calendar does not work as intended and the navigation has potential to improve.</td>
<td>Medium</td>
</tr>
<tr>
<td>System-Usage Inadequacy</td>
<td>6, 7</td>
<td>Not all the business processes can be represented in the system, such as managing the courses and fault reports.</td>
<td>Medium</td>
</tr>
<tr>
<td>Service Inefficiency</td>
<td>5, 8</td>
<td>The server is not stable sometimes and too many services are not in use. The website needs maintenance.</td>
<td>Low</td>
</tr>
</tbody>
</table>

Problem 1: The differences between the mobile and the desktop versions are significant. Not only they have different UI, they also have different functionalities. They are two separate WISs with some shared tables. As the screenshots shown below, for the same working order overview tab, the information is displayed in completely different ways. In the mobile version there are only three categories “Created”, “In Progress”, and “Ended”. However, in the other version, one more category “Billed” has shown (Figure 4.6 & 4.7). It is also required to change the setting to view the detailed information in the mobile version, instead of showing them directly as the desktop version does.
The mobile version focuses on the actual orders, which includes adding/editing clients and orders, viewing orders, setting costs, producing invoices, scanning objects, and viewing calendar. While the desktop version has a comprehensive set of functions, including those mentioned in the mobile version, it also can create detailed client...
information, object information, be connected to other financial system and so on. This means that certain functions can only be achieved through the desktop version. What makes the matter worse is that the interaction between the mobile and desktop version is underdeveloped. It is understandable that there will be differences when using the mobile version offline. Nevertheless, even when changes are made in the mobile version online, some special instructions must be followed to reflect them in the desktop version, and vice versa. It has to be done through the synchronization function for both versions.

Problem 2: The field service management system is not designed to manage from an object’s level. The system is organised by different clients and instead of objects. The desktop version BUK AB has been using has configured to include two new properties, namely agreements and objects. In this case when creating an order from the desktop version, it is required to include the objects by selecting them from the existing ones as well. The agreements are set to include price, revision and other important values. Most of the tabs are organised by the clients, instead of other values, as shown in the screenshot below (Figure 4.8). One of the most distinct feature of maintenance is that it could occur after a certain period of time, however the system fails to reflect this. Even though it is possible to set a revision date for objects, the order still needs to be set manually. These configurations however are not applied in the mobile version.

Figure 4.8 History tab in the desktop version
Problem 3: The scheduling of orders is not ideal. From the mobile version (Figure 4.9), when creating an order, it cannot be set on a certain day. After creation, the order is shown first under the “Created” orders and will stay under “Created” tab until changes have been made to it. In order to book a time, it is required to swipe the screen to get the side bar to book the time and add description. The calendar function in the desktop version is more advanced. An Outlook liked calendar can manage calendars from different workers (Figure 4.10). However, under the calendar view, it is not possible to view the actual order except the description added to the calendar item.

![Figure 4.9 Booking function in the mobile version](image)

Figure 4.9 Booking function in the mobile version
Problem 4: The location based navigation function is disappointing. It shows the selected order from the mobile version. Since the calendar is not directed linked to the orders, it could not provide the optimal route when there is more than one order per day.
Problem 5: There are some minor issues that could be improved. For instance, the server itself is not stable, which means it is difficult to get connected sometimes. The participants are not using all functions thus making some subtabs reductant. And the invoices created by the field service management system still need to be edited and sent through emails to the clients.

Based on the analysis from interviews and documents, some other IT-related issues are discovered as well:

Problem 6: Training as one of the most important business functions does not have its own management system. The trainer sets a schedule on the website (Figure 4.12) and the potential clients can select and book them from the websites. Special courses need to be communicated through the request form on the website or personal email exchanges. This means that the training system is organised through emails in most cases.

![Figure 4.12 Booking courses from the website](image-url)
Problem 7: Fault reports and maintenance reports are filed through their websites. Similar to how it works with booking training courses, those reports will be sent via emails and the technicians need to register them manually to the system (Figure 4.13).

![Figure 4.13 Sending fault requests from the website](image)

Problem 8: There are some minor issues with the website: certain links direct to blank pages. Some pages appear under several tabs. Side bars are not organised. These issues do not have an obvious impact on the business process, however it is still worthwhile to take them into consideration.

4.5 Summary

BUK AB is a local fire protection and training consultancy. In terms of IT needs, it has a customised website made from WordPress to promote its business. To keep both internal and external communication, BUK AB uses email mainly. It also acquires and uses a web-based financial system, and a field service management system with two versions, a web version and a mobile version.
An initial analysis was conducted to understand the business model and process. By developing Business Model Canvas, it could be concluded that important activities are consulting/training, marketing, selling fire protection-related products and conducting maintenance. Moreover, BPMN process models were generated to identify different actors and business transactions involved in different processes.

Based on the found documents and interviews, five problem categories were discovered, namely version difference, system incapability, functionality incompleteness, system-usage inadequacy and service inefficiency. All the problems are concerned with either functionality or UI aspects, or both aspects of the system.

The problems discovered indicate a huge potential to improve the system by applying customisation. In the next chapter, some suggestions are given based the results from Multiview framework to deal with the problem situation.
5. Application and Results

Problems with the system were identified after conducting first few stages in the research process. In this section, the situation was investigated further by applying WIS development methods under Multiview framework (Vidgen 2002), which guided the entire application process. As a result, five aspects are examined to fulfil the analysis and design stage from a system customisation process. For each stage there are a specific goal and outcome. Organisational analysis investigates the business model, and the information analysis explores the technical requirements. Work design focuses on the job satisfaction aspect, technical design is about the databases and finally HCI design is concerned with user interfaces. Furthermore, some customisation suggestions are given based on those documents generated from analysis and design to solve the problem situation. The implications from the suggestions will be introduced in the next chapter.

5.1 Multiview Framework

One of the most distinguished feature of WIS development under Multiview framework is having multiple perspectives, namely technical, organisational and personal. This is accomplished by applying the WIS Development Methods, based on the problems from the initial analysis. In this overview of Multiview framework (Figure 5.1), based on the problem description and documents generated from WIS Development methods, customisation suggestions are given accordingly.

Different approaches are used in the analysis and design phrase. In organisational analysis for instance, Soft Systems Methodology (SSM) is a suggested approach to tackle this problem (Checkland 1999). SSM is useful for complex situations when there are many stakeholders come into the play. It is often used in an action research to better understand different people involved in different situations. There are in total seven steps to conduct a logical sequence, even though the sequence is not a set of stone. A study can occur at a selected stage and/or iterate at certain stages. As the illustration shown (Figure 5.2), some stages belong to the “real world” while the others are within “system thinking about the real world”.
The stages are:
Stage 1: To enter and unstructured situation that considered to be problematical.
Stage 2: To express the problem situation.
Stage 3: To formulate the root definitions of relevant systems.
Stage 4: To build conceptual models by using root definitions, system concepts and system thinking.
Stage 5: To compare the conceptual models with the real life scenario (between stage 2 and stage 4).
Stage 6: To define possible changes which are possible and feasible.
Stage 7: To take actions to improve the problem situation.

5.2 Organisational Analysis

Value creation is critical to all kinds of business. In order to understand the organisation better, it is almost an obligation to know first about the business it is doing and how it conducts. As mentioned in literature review, one of the most important competitive edges of SME is the unique business process. The newly acquired system should not be implemented on the price of sacrificing it. However, it is not enough to understand the whole situation by just knowing the business models from the initial analysis. The Business Model Canvas does not include the actual IT-related interactions between stakeholders and expose problems.

In this study, the organisational analysis is based on the notes and transcription from the interviews and documents. Some artefacts are generated based on SSM after stages 1 to 4, namely rich pictures, root definitions and conceptual models. Rich pictures are meant to understand the organisational context and culture, and to identify stakeholders and actors. They are the outcomes from stages 1 and 2. They describe the situation through making and linking concepts together. Even though there is no strict syntax of rich pictures, the key elements are symbols, links and problems. As illustrated below (Figure 5.3), a rich picture has been created to provide an overview of the situation in BUK AB. IT Service is the main concern and the actors, clients and activities are highly involved. Four actors are identified, namely the technician, trainer, employee and supplier. They represent activities like maintaining, training/consulting, book keeping and purchasing.
From stage 3, the goal is to make conceptual models, but first root definitions need to be described. Root definition points out the key transformations and the main elements are Customers, Actors, Transformation, Weltanschauung, Owners and Environmental Constraints (CATWOE). A root definition and CATWOE are need for each system identified from the rich picture. In this study, two systems are relatively important: a field service management system to handle from an object’s level; a training management system to publish and update courses, and maintain consult services. There is however a third system, i.e. a financial system to keep orders and invoices in place. It is working fine according to the participants thus it is not under concern in this study. Next, conceptual models identify the patterns in the knowledge activities as outcomes from stage 4. Those models include the activities in order to achieve the transformation and how to monitor the operation. Two systems are presented here with their own root definition and conceptual model.

Field service management system (Table 5.1 & Figure 5.4) is about the use case when a technician receives an order from client or when a recurring order appeared. He/she...
needs to conduct the service and if the part required is missing, it should be ordered from the supplier. The employee will then keep track of the financial interaction between the supplier and send invoice to the client.

**ROOT DEFINITION – FIELD SERVICE MANAGEMENT SYSTEM**

A system owned by the technician, who together with the support of the employee, uses knowledge, skills and experience to install, inspect, fix and maintain fire protection-related products. This is undertaken with the understanding that the technician wants to achieve efficiency during maintenance projects, which in turn saves the clients’ time. This process needs to consider the quality, and cost and time used for the service.

**Customer:**
- The client

**Actors:**
- The client, the employee, the supplier.

**Transformation:**
- To use knowledge, skills and experience to install, inspect, fix and maintain fire protection-related products.

**Weltanschauung:**
- The technician wants to achieve efficiency during maintenance projects, which in turn saves the clients’ time.

**Owner:**
- Technician

**Environment:**
- Quality, cost and time critical.

**Table 5.1 Root Definition – FIELD SERVICE MANAGEMENT SYSTEM**

<table>
<thead>
<tr>
<th>Role</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Client</td>
<td>Get details of the technical details of the products</td>
</tr>
<tr>
<td></td>
<td>Understand client’s expectation for service and value</td>
</tr>
<tr>
<td></td>
<td>Keep track of financial aspects from the request</td>
</tr>
<tr>
<td></td>
<td>Provide new parts if needed</td>
</tr>
<tr>
<td>Employee</td>
<td>Consider service options on the information received</td>
</tr>
<tr>
<td>Supplier</td>
<td>Perform Service</td>
</tr>
</tbody>
</table>

**Figure 5.3 Conceptual Model – FIELD SERVICE MANAGEMENT SYSTEM**
Training Management System (Table 5.2 & Figure 5.5) is about the use case when a trainer updates the training or consulting schedule on the website, or when client inquiries about the service. The trainer needs to update the course schedule based on the demands. The employee will then keep track of the invoices based on the courses and frequencies.

**ROOT DEFINITION – TRAINING MANAGEMENT SYSTEM**

A system owned by the trainer, who together with the support of the employee, use knowledge, skills and experience to educate clients with proper fire protection related knowledge and offer customised consultancy services. This is undertaken with the understanding that the trainer needs to make sure the content is relevant to the client, with enough background study before the training or consultancy. This process needs to consider the accuracy, quality, and cost and time used for the service.

**Customer:** The client

**Actors:** The client, the employee.

**Transformation:** To use knowledge, skills and experience to educate clients with proper fire protection related knowledge and offer customised consultancy services.

**Weltanschauung:** The trainer needs to make sure the content is relevant to the client, with enough background study before the training or consultancy.

**Owner:** Trainer

**Environment:** Accuracy, quality, cost and time critical.

Table 5.2 Root Definition – TRAINING MANAGEMENT SYSTEM

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Get details of the client’s request and location</td>
</tr>
<tr>
<td>2</td>
<td>Understand client’s expectation for service and value</td>
</tr>
<tr>
<td>3</td>
<td>Organize course and consultancy options based on the request</td>
</tr>
<tr>
<td>4</td>
<td>Keep track of financial aspects from the request</td>
</tr>
</tbody>
</table>

**Figure 5.5 Conceptual Model – TRAINING MANAGEMENT SYSTEM**
From stage 5, the methodology moves to compare models generated with reality and apply the changes. In this study, the prototype developed and the customisation suggestions are used as an implementation for stages 5 to 7, which can be found in the section 5.7 Customisation Suggestions.

5.3 Information Analysis

Unified Modelling Language (UML) is used as the key method to gather technical requirements specification. It is critical during the information analysis and a general description of the major functionality should be visualized in a certain way. There are different structural and behavioural UML diagrams, and in this study generating class diagrams is set as one of the priorities. A class diagram is a structural diagram that focuses on the classes, attributes, methods and relationships among objects in the system.

Classes from the current system are Order, Object, Client, Invoice and API to the financial system, which are still required in the potential new system. Figure 5.6 is the class diagram generated after several iterations and more classes like Calendar, Worker, Part, Service and Agreement have been identified. It can be observed that class Order is the main class and is connected to all the other classes to a certain degree. This indicates that Order still is the most important functionality in the new system. Certain classes are dependent on other ones. In order to construct an Order, classes like Client, Service, Invoice, Calendar and Part must be included. Agreement is constructed by Client and Service. And Service is by made Object and Worker.

Furthermore, class Object means more than just the fire protection items in the new system. It has the possibility to describe courses and consultancy service by inheritance. The information analysis points out a direction that new system should be. By following the class diagram, it will make sure that the system includes all the functionality BUK AB needs to achieve its activities.
5.4 Work Design

Following the ETHICS approach to the sociotechnical design, the goal was first to balance the job satisfaction and the efficiency objectives of the organisation (Mumford 1995). However, since the users may not only be the employees, the job satisfaction has been shifted to user satisfaction. The system should always assist the work and achieve better user satisfaction instead of ruining one. WebQual was developed as a tool to assess how the organisation performs in three categories, namely usability, information quality and interaction (or service) quality, which falls under 12 different constructs (Loiacono, Watson & Goodhue 2003). Due to the fact that it is a questionnaire that targets on e-Commerce, some questions do not apply in this specific case. A customised WebQual 4.0 questionnaire was produced (Appendix) to allow comparison before and after the implementation of new system. It has a Likert scale from 1 to 7. 1 represents strongly disagree and 7 represents strongly agree. The
The aim of work design is thus to achieve a higher user satisfaction in all the categories after applying the new system.

5.5 Technical Design

Technical design represents software model. One of the most important results from the software model is the database design. An Entity-Relationship (ER) diagram consists of different data models that describe how an implement to a data or information structure could turn out in a database. It is a useful tool to develop the database design. Different levels of abstraction can be applied to ER models, such as conceptual data model, logical data model and physical data model. Conceptual data model captures the general requirements for the model set and will be used in this study. Figure 5.7 provides a specific design of the data models and databases. Some key relationships can be observed, such as Order with Service, Service with Object and Worker.

![Figure 5.7 Entity-Relationship Diagram]

**Figure 5.7 Entity-Relationship Diagram**
5.6 HCI Design

Human-Computer Interface (HCI) as the newest quadrant added to the WISDM compared to the traditional ISDM, is located in the overlapping area of both work and technical design. It is about the aesthetics of the user interface design especially while achieving better user satisfaction and efficient data model. It is an established practice to imitate exemplars from other similar web sites to get inspiration. Currently there are many other webpage-based field service management systems available that have a smooth user experience. It is observed that a Module Tab design is the most popular UI design pattern within field service management WIS, which is constructed by a tab control area, tab control, tab control text, active/inactive tab control, pane content and active/inactive panes. The aim of using this design pattern is to maximize the usage of the screen, and allow the users to view a set of data once at a time. There are general guidelines to reach a better design, such as:

1) Distinguish the active tab from the inactive ones.
2) Allow a horizontally-oriented tab controls.
3) Make switching in between panes fast.
4) Keep names for tab control texts short and logical.
5) Minimize scrolling inside the panes.

Both of the investigated systems are applying this pattern to a certain extent. WIS A (Figure 5.8) has six tabs, five presented by an icon and a tab name, one by an icon. The schedule tab as shown below has a function to search the optimal schedule for orders. It is based on the priority of the orders, the availability of the workers assigned to and the location of the clients. Different routines will be calculated and presented and the user could choose to select one and set it as the main schedule or apply changes and make own preference.
WIS B (Figure 5.9) has six tabs, namely Lobby, Work Order, Time Reporting, Calendar, Help and The Admin Panel. For the Work Order tab shown below, there are three extra sub tabs, and it includes a search bar under the sub tab control before showing the detailed work orders. It allows the users to have a fast navigation within the orders. Orders can also be sorted ascending or descending by clicking the category name. Columns can be customised by the users, which means that the sequence of the columns can be changed, added and deleted.

5.7 Customisation Suggestions

Based on the results from WIS development methods, several customisation suggestions are proposed to deal with the problem identified in the previous section (Table 5.3). A simple skeleton prototype has been implemented to indicate some improvement directions as well. It was developed by using ASP.NET MVC Framework. MVC is a tool to build web based applications and systems, which stands for a programming design pattern “Model View Controller”. Model is the data layer for
business logic. View is for the presentation layer and controller is to manage the flow between model and view and user interaction. Other suggestions are illustrated by examples from other existing systems.

<table>
<thead>
<tr>
<th>Problem</th>
<th>Priority</th>
<th>Customisation Suggestion</th>
<th>No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Version Difference</td>
<td>High</td>
<td>To avoid the difference between UIs and functionality by using a web-page based WIS is a solution.</td>
<td>1</td>
</tr>
<tr>
<td>System Incapability</td>
<td>High</td>
<td>To make Object an individual function, connect it to Order and Calendar and at the same time allow define default constants.</td>
<td>2, 3</td>
</tr>
<tr>
<td>Functionality Incompleteness</td>
<td>Medium</td>
<td>To create orders directly from the Calendar tab and enable scheduling and navigation on the Map tab.</td>
<td>4</td>
</tr>
<tr>
<td>System-Usage Inadequacy</td>
<td>Medium</td>
<td>To include training and consulting in the system by treating the instances as objects.</td>
<td>5</td>
</tr>
<tr>
<td>Service Inefficiency</td>
<td>Low</td>
<td>To try out SaaS service and hide abundant tabs.</td>
<td>6</td>
</tr>
</tbody>
</table>

Table 5.3 Problems with their customisation suggestions

**Suggestion 1:** For the cross-platform use of an information system, a web-page based WIS is the most popular choice. As long as there is web browser available, the system could be reached and viewed. Since the prototype is a web project, the mobile and web version are the same. They have the same functionalities and need to have internet connection to view, use, or apply changes. This implies that one version from the field service management system investigated need to be selected and made into a web-page project.
Suggestion 2: Constants like workers, clients, parts, services need to be predefined. It is often needed to enter the same set of information when creating an order, which is redundant and not user-friendly. As indicated in the information analysis and technical design, one solution is to allow user to create information like client and worker (Figure 5.10) from the basic setting and then they can be directly selected for other functionalities, like creating a new Order.

![Create a New Client](image)

Figure 5.10 Screenshots from Client and Worker Creation (Prototype)

Suggestion 3: Objects should be not optional when creating an order. Since the core business of BUK AB is about fire protection objects, each object should have a category and an individual ID to identify them separately. Especially when creating an agreement or and order, it needs to specify which objects need to be included according to the information analysis and technical design. As shown in the
screenshots (Figure 5.11), it is required to enter the object category and ID upon the creation of order. Orders can also be reviewed and sorted by the object category.

![Image of order creation form]

**Figure 5.11 Screenshots from Order Creation and Overview (Prototype)**

**Suggestion 4:** Calendar function needs an individual tab to manage orders **effectively.** Using tab design is just a start. WIS A features a calendar and map function (as shown below Figure 5.12) when viewing the Plan tab, which also enables the overview of schedules from different workers. The orders can be directly edited from the calendar view. The orders are also pinned at the map, by showing the **appointment time relatively.** WIS A implements Google Maps and Calendar APIs, which also means that the pinned locations, the calendar items can be synchronised and viewed outside the system.
Suggestion 5: Instances from training and consulting can be managed as objects in the same manner. An object here refers to a product or a service, which means it can be tangible or intangible, according to information analysis. As a direct outcome from training, course for example is treated as an object (as shown below Figure 5.13). Courses are managed in Order as the other objects. The system in this case can be viewed as a booking system.

![Figure 5.13 Screenshot from Object Creation (Prototype)](image)

Suggestion 6: Service like cloud computing will increase the server stability and speed. By using SaaS (Software as a Service) model, the provider hosts the application on a cloud infrastructure and can be accessed from clients’ devices. In addition, configurations from the client side can also be done to hide the functionalities that the client does not need.
5.8 Summary

Multiview framework brings different perspectives when investigating a problem situation. Five stages, namely organisational analysis, information analysis, work design, HCI design and technical design all have different objectives. The ultimate goal is to achieve some solutions by creating artefacts.

First of all, organisational analysis is the most important method to deal with complex situations. By applying SSM, a rich picture was generated to identify stakeholders and actors like technician, trainer, employee and supplier. Activities like maintaining, training/consulting, book keeping and purchasing are also represented. Root definitions and conception models were then made to describe two key systems: field service management system and training management system. These are improved business and process models compared to the ones from the previous chapter. Secondly, a class diagram was developed under information analysis to examine different classes needed in the systems. Since the fire protection objects and courses can be described in the same manner, class Object includes items and services by using inheritance. Thirdly, a WebQual questionnaire was produced under work design to determine if the job satisfaction can be improved after customisation. The questionnaire was edited to fit the situation better. Next, in the technical design, a suggested database design was illustrated by an ER diagram. Database Object for instance needs to be connected with Service, Calendar, Client and Agreement. The final aspect is HCI design, and it was concluded that a Module Tab design is a popular choice by analysing established website exemplars WIS A and WIS B.

After the analysis process, the suggestions were given to the problems identified in the previous chapter. A web-page based WIS could be a solution to the version difference, in this way the functionality and UI can be the same regardless of the platform. Next, object is the focus of BUK AB, so it should have an individual tab. More functions should also be improved around it, like the Order and Calendar. Furthermore, one way to manage the business more effectively is to manage processes like training and consulting the same way as maintaining products. Lastly, applying technologies like cloud computing and SaaS will make the service more efficient.
6. Conclusion

Customisation suggestions from Chapter 5 were given based on the results from the Multiview framework to solve the problems discovered in Chapter 4. In this chapter, a discussion is presented first to explain the results and how to interpret them. A brief summary is then given to conclude the study. Lastly some research directions are also provided to inspire future research.

6.1 Discussion

SMEs have different needs for IT service and system. Regardless of the system, the provider has to make customisations and configurations for the clients. BUK AB unfortunately did not receive a good customisation service, which resulted in some issues that hindered the business development. The WISDM under Multiview framework is chosen as the main theoretical framework from Chapter 3. Customisation suggestions from Chapter 5 are given based on the problems identified in Chapter 4 to reveal this situation and the results can be used as a reference to similar problems. Short reviews are provided below to discuss the suggestions with their problems.

**Version Difference:** The WIS investigated has two versions, one for desktop and one for mobile. This means that they have different UIs and functionalises. Certain functions can only be achieved in one version instead of the other. A solution is to select one of the versions and make it available on the web page. In this way as longs as there is a web browser, the system can still be accessed online in spite of different platforms. Since most SMEs don not have a large scale of business, a light-weighted webpage WIS is enough to handle business need and save costs, instead of acquiring a comprehensive system from well-established software provider.

**System Incapability:** The system is organised by clients instead of objects. Some configurations have been done to include objects in the order creation process, however there is no existing functionality to organise objects effectively. A solution is to extent class Object and link it with other classes like Order and Calendar.
creating a new order, an object must be selected along with some constants like workers, parts and services. Those constants need to be predefined because they recur in orders. By creating a setup tab to include the set of constants is a popular choice among many WISs.

**Functionality Incompleteness:** Functions like scheduling and navigating are underdeveloped in the system. For scheduling, orders can only be set to a certain date and cannot be viewed from the calendar. In addition, due to the recurrence nature of maintenance-related work, the orders cannot be generated automatically. These problems can be solved by enabling a new Calendar tab which includes the orders and worker’s schedule. Orders can be viewed in the calendar directly after creation. Depending on the priority and recurrence, the presentation could differ from order to order. In addition, the existing navigation function is useful for a single order but it cannot deal with the optimal routine with multiple orders. A rework on the navigation is suggest to generate a routine according to the location, priority and the availability of the worker. By connecting to a map service, it is better to show the routine visually.

**System-Usage Inadequacy:** Not all the business processes have a corresponding system. Training and consulting for instance are organised by email conversations. Filing fault report and maintenance reports are achieved through website. The former can also be treated as other objects in the system. The related function is the booking function and is the same with organising orders in essence. The latter problem is not in the scope of the study, however, the work flow will be more smooth if the website can be connected to the system by API. In this case, the reports will be sent directly into order items.

**Service Inefficiency:** Minor IT-service related problems have also appeared during the investigation. The WIS is connected to the system provider’s database. Sometimes the connection is not stable and the service will be interrupted by unexpected events. As an improvement, using cloud service will increase the stability. In addition, the system offers functions that BUK AB does not need, which makes some tabs obsolete. This can be solved by configuring the tabs from the client side and hide those functions. Finally, the website also needs to be updated often so there will not have some invalid references and unorganised tabs.
The result from this research can be applied as the preliminary study for SMEs in service industry with their special focus on objects. Objects here mean products and service. Maintenance industry for example, has to manage tons of objects and by having a standard IS cannot handle this issue alone. Therefore, there is a huge potential behind this market and system providers need to look into this issue and even make their special versions to fit more to the business model. Technical issues might be tricky in this process, since WIS does not allow a total makeover for the entire system. However, at least new data fields and relationships should be applied to suit the special business models and configurations need to be done to improve the user experience.

6.2 Conclusion

SMEs are contributing to the world’s economy significantly. In Sweden alone more than 99% of all the companies registered in 2015 were SMEs and one-man business was around 73%. SMEs use IT services like website, emails and information systems. A WIS is one of the popular choices for the SME. It offers effective and efficient solutions of managing their business with the feature of cross platform and online. Every system needs to be customised to a certain degree before being applied to an organisation. Especially for SMEs, the unique business model is the key of success and the system should support the model instead of altering it.

Previous studies have been conducted regarding to the WISDM. Using Multiview framework is a wise decision since it considers stakeholders involved in the system together and provides multiple perspectives, namely technical, organisational, and personal. The solution is not only on the engineering side, but is also derived from a sociotechnical aspect. Moreover, another difference from previous methods is the new aspect of HCI, which aims to improve the user interface. With a focus on design and analysis, documents especially models are generated during the development process under Multiview framework. The life cycle model of system customisations indicates that design and design analysis are the first steps to achieve a decent customisation. It is also discovered in the literature review that previous research is
about ERP systems in SMEs, some of which are not even WISs. It is not clear what kinds of problems SMEs have when using a WIS. When it comes to the actual customisation, research tends to focus on evaluation of the results instead of how to perform a customisation.

This study explores the possibility to conduct some early stages in customisation under the Multiview framework, namely the design and analysis phrases. It is a qualitative study with a combined research strategy (a single case study and a design and creation). The case was conducted with BUK AB, a local fire protection and training consultancy in Uppsala Sweden. It was an exploratory study where interview was used as the main data collection method. A list of problems was discovered through an initial analysis by examining the business model and business process. Having an overview in mind, WIS development methods matrix under Multiview Framework was applied to the situation, which provided a comprehensive methodology for WIS development. This was conducted in design and creation strategy. Interviews and documents were collected and qualitative data analysis was applied afterwards. Customisation suggestions were created based on the results to tackle the problem situation. Moreover, research questions from Chapter 1 can be answered from the results. Since it is a case study, the results will be generalized and reflect the phenomenon.

1. **What kind of IT systems does a SME in the service industry need?**
A SME needs at least three kinds of IT systems to maintain its business efficiently. A website or blog to reach out to the clients. A communication system like emails to keep the communication internally and externally. And most importantly a management system to run the business. From the case study, BUK AB for example uses a website and emails to communicate with its clients. The website is built with the support of a customised WordPress template, which serves as a marketing tool and gets attention from potential clients. Internal communications are achieved by company emails and telephone calls. For its business, it uses a field service management system (two versions, desktop and mobile versions) and a financial system (web based) to manage its main business. Systems are connected by APIs.
2. Are there any problems with the IT systems?
Because of the unique business model, most standard information systems need to be customised to fit SME better. Depending on how customised the system is, many SMEs will still encounter some problems. Some common ones like connection error can be solved by just calling the customer support. However other issues need extra attentions and need to be taken care of as soon as possible when they appear.

Due to the characteristics of SME, a standard WIS will probably not support the unique business process. It is almost impossible for SME to change its competitive edge; thus it is the system which has to change. Most of SMEs do not have professional IT supports, so they rely heavily on the support from the system provider to configure and customise the system. In the case study, BUK AB has some major issues with the field service management system, which cannot be easily solved just by calling the support. The problems are version difference, system incapability, functionality incompleteness, system-usage inadequacy and service inefficiency. If the issues could not be fixed in time, the job satisfaction will be decreased significantly and the profit would even drop in the worst case scenario.

3. How can system customisation under Multiview framework deal with the problems?
Problems occur because the system does not support the business model. As a solution, system customisation under Multiview framework can tackle the problem from a sociotechnical perspective. System customisation can be conducted in different ways. A common practice is to start with the design and analysis processes. Multiview framework provides a WIS development matrix on organisational analysis, information analysis, work design, technical design and HCI design. From each stage there are specific goals and artefacts generated to aid the process.

First of all, organisational analysis is deal with complex situations, and identify stakeholders and the relationship among them. Secondly, information analysis gathers the technical requirements needed in the new system and visualize them by generating models. Next, work design provides a questionnaire to compare the user satisfaction before and after the customisation. Technical design on the other hand
generates the software models to reflect the results from the information analysis. And finally HCI design achieves a better designed UI.

After applying the Multiview framework, suggestions and potential solutions can be given to deal with the problems identified. In this case study with BUK AB, the problem of version difference for example, can be solved by selecting one version from either the desktop or the mobile version and make a web-page based version instead.

6.3 Future Research

The main focus of the study is the system customisation process. However, system customisation does not end at the analysis and design process. To study the entire development cycle of WIS customisation is critical and will provide valuable insights on establishing and validating the exiting process and practices. In order to achieve this, it requires a study of an actual project between the system provider and the client. To document the process will help improving the exiting methodology.

Another aspect for future research is the WIS in question. The investigated WIS with a focus on objects should be improved and customised. There is a huge market potential for similar SMEs in the service industry.

Finally, an action research with a focus on how the business performs before and after customisation can be conducted. Not many studies have done in this area to compare the difference. The result from the study will either validate or reject the hypnosis that the customisation will improve the business process in the long run.
7. **Reference**


## Appendix  WebQual 4.0 Questionnaire

<table>
<thead>
<tr>
<th>Category</th>
<th>Questions</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Usability</strong></td>
<td>1. I find the WIS easy to learn to operate</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td></td>
<td>2. My interaction with the WIS is clear and understandable</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td></td>
<td>3. I find the WIS easy to navigate</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td></td>
<td>4. I find the WIS easy to use</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td></td>
<td>5. The WIS has an attractive appearance</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td></td>
<td>6. The design is appropriate to the type of WIS</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td></td>
<td>7. The WIS conveys a sense of competency</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td></td>
<td>8. The WIS creates a positive experience for me</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td><strong>Information</strong></td>
<td>9. Provides accurate information</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td><strong>Quality</strong></td>
<td>10. Provides believable information</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td></td>
<td>11. Provides timely information</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td></td>
<td>12. Provides relevant information</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td></td>
<td>13. Provides easy to understand information</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td></td>
<td>14. Provides information at the right level of detail</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td></td>
<td>15. Presents the information in an appropriate format</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td><strong>Service</strong></td>
<td>16. Has a good reputation</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td><strong>Interaction</strong></td>
<td>17. My company information feels secure</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td></td>
<td>18. Creates a sense of customisation</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td></td>
<td>19. Makes it easy to communicate with the organisation</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td></td>
<td>20. I feel confident that services will be delivered as promised</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td><strong>Overall</strong></td>
<td>21. Overall view of the WIS</td>
<td>1 2 3 4 5 6 7</td>
</tr>
</tbody>
</table>