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# Effective e-procurement implementation in the public sector

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Abstract Currently there is a trend towards increased focus on the importance of the purchasing function and costs of maintenance, repair, and operation (MRO) goods. This has led to companies investing in electronic procurement tools in order to reduce those costs and increase efficiency. However, studies have shown that only 20-27% of these investments are successful. To ensure the success of such investments, it is beneficial to consider critical success factors (CSFs) covering important aspects of the implementation. The aim of this master's thesis is to validate and assess the relevance of a framework covering eleven CSFs for three distinctive project phases of an electronic procurement implementation. The main research question is "Are different CSFs more or less relevant for different types of end-users in an e-procurement implementation context?", but is limited to some parts of the framework considering its comprehensiveness. The purpose of the framework is to aid managers in decision-making by presenting a framework with clear managerial implications. In addition, the framework is also intended to assist the ongoing implementation of an electronic ordering system at the case company, St Olav's Hospital, to which both this master's and our pre-diploma thesis were written in collaboration with. The framework in focus was developed by us in our pre-diploma thesis, but although looking promising, it needed further validation. This master's thesis will continue the work by employing a case study survey research design and quantitatively analyzing the results of a survey deployed to 803 end-users at the case company, capturing the end-user perspective of the implementation. The findings of the thesis show that some of the investigated CSFs are indeed important to the sample of end-users, and that there are differences, especially regarding sex and age, in how important end-users consider the CSFs to be. For example, training is found to be more important for both females and for older respondents, while communication is found to be important for all end-users. Moreover, an exploratory factor analysis suggests that there is room for improving the framework, by finding that the perceptions towards electronic systems are important to consider. Furthermore, these findings imply that companies should not only consider the CSFs in the framework, but also the differences that may exist between end-users.

*Keywords:* logistics, forwarding company, 3PL(Third Party Logistics), 4PL (Fourth Party Logistics), supply chain.

#### **1.0 INTRODUCTION**

"A \$500 million manufacturer of steel products rolled out an e-Procurement pilot project to its plants. The company did not have a change management plan or an overarching procurement strategy. Employees resisted the use of unfamiliar tools and the introduction of revised buying procedures. Despite later mandates by company executives, the lack of early focus on change management resulted in poor adoption and therefore no substantial savings." ICG Commerce – reasons e-procurement projects fail to achieve their ROI, white paper (ICG Commerce, 2009). Electronic procurement (hereafter called EP or e-procurement) refers to the use of internet technology in purchasing processes (De Boer et al., 2002). Purchasing can be defined as externally obtaining all goods, services, capabilities, and knowledge which are necessary for running, maintaining, and managing the company's primary and support activities (Weele, 2005). Companies both privately and publicly held are increasingly realizing the potential benefits of e-procurement (Croom, 2000, De Boer et al., 2002, Puschmann and Alt, 2005, Reunis et al., 2006, Vaidya et al., 2006). In fact, public sector organizations worldwide have identified e-procurement as a priority and have implemented or are in the process of implementing e-procurement (Vaidya et al., 2006). Previtali (2012) finds that the public

procurement of goods and services are strategically important for at least three reasons: 1) The economic impact is between 15-20% of the GDP of European countries. 2) It is relevant for potential improvements in public services. 3) It affects both the competitiveness of nations and the welfare of citizens.

Procurement usually represents one of the largest expense items in a firm's cost structure (Angeles and Nath, 2007). The Aberdeen Group (2001) finds that the purchase of maintenance, repair, and operations (MRO) goods usually account for 30-60% of a firm's total spending. MRO goods are products such as office supplies, personal computers, non-manufacturing items, etc. (Angeles and Nath, 2007). Furthermore, Turban et al. (2006) find that corporate buyers tend to waste time on non-value adding activities such as data entry, expediting delivery and correcting errors in paperwork. The possible benefits from an e-procurement system are, for instance, shorter order cycles, higher compliance with purchasing contracts, and increased negotiation leverage leading to lower costs (Arbin, 2008b, Croom and Brandon-Jones, 2007, Puschmann and Alt, 2005, Reunis et al., 2006). However, such systems are not always implemented successfully. A study by Boston Consulting Group in 2001 found that only 20% of all e-procurement investments were successful (Caniato et al., 2012). A similar study by Calyptus Consulting Group in 2009 reported this value to be 27% (Caniato et al., 2012). As illustrated by the introductory example as well, it is important to understand what drives a successful implementation in order to reap the gains from investments in e-procurement initiatives. One such driver is adoption of the system by the end-users. Adoption of the system is critical, and without, the gains can evaporate (Arbin, 2008b, Reunis et al., 2006).

## 2.0 THEORY, FRAMEWORK, AND HYPOTHESES

In this section of the paper, the theoretical basis for this master's thesis is presented in order to address research question 1 - What are critical success factors for e-procurement implementation in the literature? First, we will briefly discuss the methodology approach used to form the theoretical basis in the pre-diploma thesis, as this founds the theoretical basis for this master's thesis. Next, we present relevant theory on purchasing regarding e-procurement and CSFs found in literature, before moving the framework. We will decompose the framework for brevity instead of developing it from scratch, which was the case when constructing it. Therefore, we will only briefly explain the contents of the framework and how it was developed. Finally, we present the hypotheses in order to address research question 2 - What is likely for the different end users to assess as important?

## 2.1 Methodology underlying the framework

Before presenting the framework developed in the pre-diploma thesis, the underlying methodology of the development is introduced briefly. When developing the framework, we employed an analytical conceptual approach rather than an empirical one, due to limited access to the case company. Wacker (1998) defines this type of research as aiming to add new insights by logically developing relationships between concepts into an internally consistent theory. Furthermore, the distinction between e-procurement and e-ordering, as discussed in section 1.2, was a key driver to how the literature searches and review was conducted. A change in the review question from what is known about critical success factors of e-procurement to entailing e-ordering instead resulted in a shift in the review approach from systematic to narrative. Using the narrative approach via snowball sampling was the only feasible choice to investigate the scarce research on e-ordering. However, aiming to find relationships between concepts from both e-procurement and e-ordering, literature findings from the systematic approach was kept. In addition, relevant theory and concepts of change management were added to the literature search. In addition to acting as a backdrop, change management was included to serve as both as an interface and a supplementary perspective to possible concept relationships.

Wacker (1998) states that case studies are often applied to illustrate examples when employing an analytical conceptual research approach. The empirical data was gathered using semi-structured interviews with seven individuals and by examining a myriad of documents relating to the e-ordering project at St. Olav's. Of the seven interviews, three of the interviewees were end-users, two having used Visma. By collecting opinions and predispositions toward an electronic ordering system, the overall target was to provide examples and insight to the developed framework. Employing only a single exploratory case study did limit generalization of the findings ascertaining the relevance of the framework. Moreover, as only three end-users were interviewed, this inhibited the possibility to generalize the findings to a larger group of end-users at St. Olav's.

Furthermore, regarding limitations, the theory behind the framework, especially the CSFs, were mainly from findings in the public sector although findings from the private sector were used as supplements. As the framework was only applied on St. Olav's, which is a publicly held company, this implied that further validation is necessary, for instance, in case studies where the focal companies are privately held, in order to ascertain if the framework is applicable to the private sector. Another limitation relevant for the findings is in regards to where the theory findings are originally from, i.e. nationality. Although not turning out to be an issue, some care should be included when

developing a framework by using theory based from other parts in the world and by applying it on a Norwegian company. However, it may be stated that frameworks generally are not to be used rigidly, but to have some room for interpretation and adaptation considering each specific instance they are used.

Before continuing the work of the pre-diploma thesis, we performed a new, updated literature search in order to see if there were any new discoveries since the pre-diploma thesis was written the Fall of 2014. This search did not yield any new insight, and thus did not yield any reason to revise the framework before setting out to test the framework in a survey.

## 2.2 Purchasing and E-procurement research

The importance of purchasing has increased from being an administrative function in the 1970s to becoming a function that drives the strategy of the firm (Cousins, 2008). During the first years of this century, top management began to realize that purchasing is a key contributor to corporate strategy (Axelsson et al., 2005, Puschmann and Alt, 2005). The ratios of purchasing-to-sales is usually in the range of 30-60% for service organization, and even higher in the retailing business. This illustrates the potential impact of purchasing, and a dollar saved in purchasing is a dollar added to the bottom line (Van Weele, 2005).

Purchasing is usually divided into direct and indirect purchasing. Direct purchasing is materials going into the final product, and has been the focus of management for many decades. Indirect purchasing includes purchasing of so-called MRO goods. Moreover, as mentioned in the introduction, indirect purchasing has not received the same amount of attention until the last decade. It has often been done in a decentralized and uncoordinated way (Arbin, 2008a). According to Bechtel and Patterson (1997), there are three possible explanations for this: 1) When reducing further costs in direct purchasing becomes difficult, companies turn to other areas to reduce costs. 2) Little time is spent on strategic MRO issues, since most of the time is spent on day-to-day tactical decisions and processing of routine paperwork. 3) Pressures of global competition incentivize managers to cut costs everywhere.

Based on a survey, Cox et al. (2005) find that MRO purchasing amount for up to 20% of all purchases. This is lower than what the Aberdeen Group, as mentioned in the introduction, found in 2001 (30-60%), which may indicate an increased awareness towards MRO costs. Cox et al. (2005) also find that MRO purchases in organizations still suffer from lack of internal support, maverick buying, and compliance rates as low as 25-50%. A recommended strategy for MRO purchasing is having a centralized purchasing function, using a category management strategy in combination with an e-ordering system functioning as a tool to steer purchasing orders towards suppliers, thus reducing maverick buying (Croom, 2000, Puschmann and Alt, 2005, Van Weele, 2005). As companies experience increased pressures of competition and costs reductions (Christopher, 2011), new tools to reach these goals are developed. One such gaining tool gaining popularity is e-procurement (Ronchi et al., 2010). According to Gunasekaran and Ngai (2008), the use of e-procurement is inevitable in services following the increased use of internet and electronic data interchange (EDI).

Van Weele (2005) depicts the general procurement process, which can be found in Figure 4 below. The figure illustrates the different procurement activities, ranging from the need of an internal customer, to delivery from the supplier. E-procurement refers to the use of internet-based information and communication technologies to carry out stages of the procurement process, as depictured above, such as supplier selection, sourcing, ordering, expediting, and evaluation (Croom and Brandon-Jones, 2005). There are various forms of e-procurement concentrating on the different stages. E-ordering is one such form, but generally, e-procurement is considered as an end-to-end solution. E-procurement is further a subset of e-commerce. E-commerce can be defined as doing business using Internet technology (De Boer et al., 2002).

In order to reap the gains from an e-procurement investment, as mentioned in the introduction, adoption is necessary (Arbin, 2008b, Reunis et al., 2006). Pinto and Slevin (1987, as referred to in Panda and Sahu, 2012) postulated that project success is dependent on addressing CSFs associated with the project. There is a need for a much better understanding of CSF concerning e-procurement implementation and use in the public sector. Without a set of CSFs, it seems impossible to assess the successfulness of e-procurement initiatives in the public sector (Vaidya et al., 2006). The implementation phases illustrate three distinct phases we argue e-procurement projects typically undergo. These three phases can help the organization to assess which phase they are currently in, in addition to illustrating typical characteristics of each phase. The theoretical basis and a more thorough explanation of these phases are found in section 2.4 and 2.5. The second part of the framework consists of eleven critical success factors we argue are necessary to consider in order to carry out a successful implementation of an e-procurement initiative. The blue arrows indicate in which phase each factor is most important, to increase managerial implications. Each of the critical success factors has multiple attributes (or "sub-factors") to help managers understand the substance of the factors. In some sense, an attribute is also a CSF, but on a lower level than the CSFs. A more thorough explanation of the CSFs and their attributes is given in section 2.5. It must be noted that the attributes of the CSFs are omitted from the figure above

for illustrative purposes. The framework and the following paragraphs explaining what it consists of addresses research question 1: What are critical success factors for e-procurement implementation in the literature?

#### 2.4 Change management and project phases

Chan and Swatman (1998) state that an organizational change process over time is what best describes an information system implementation. Vaidya et al. (2006) elaborate on importance of change management in light of e-procurement, and argue among several aspects that a lack of change management may lead to project failure. Consequently, we decided to have a two-pronged approach toward developing our framework, which entailed a purchasing perspective and a change management perspective. Change management played an important role in developing the framework, and served as a backdrop for the CSFs included in the framework. As explained earlier, we wanted to include project phases in our framework to increase managerial implications. A planned change approach was proved being feasible, as such models attempt to capture the evolvement of change processes, usually divided into stages. Weick and Quinn (1999) argue that planned change is categorized as an episodic change, whereas emergent change is of a continuous change nature. We argue that planned change was a suitable approach for us. The process of e-procurement implementation does not relate to continuous change; it belongs in the category episodic event. We also argue that cost intensive e-procurement systems call for a planned change regardless if the idea to implement such a system was of a reactive nature.

The focus on planned change led us to Lewin's three-stage model. Categorizing change into phases is in general a feasible tactic in order to underline the different aspects during the evolvement of a change process. However, in order to put this rather broad model into perspective, we turned to other researchers such as Levasseur (2001), who emphasizes important aspects of Lewin's three-stage model. In addition, Cummings and Worley (2015) point out that Lewin's model is comprehensive and that the model has been extended to comprise more stages that are specific. One of these is Kotter's (1995) eight-step model for leading change, which, in combination with Lewin's model and Levasseur's (2001) specific properties of the three stages, was used as a backdrop of relevant change models. However, it was also necessary to put the change models in context of an information system implementation. Caniato et al. (2012) propose an implementation framework to identify main decisions companies should take during e-procurement adoption. On that note, adoption will first be defined due to its importance in information systems implementation in general, the eleven CSFs, and Caniato's et al. (2012) model

Rogers (1995, referred to in Reunis, 2007, p. 17) defines adoption as "the process to make full use of an innovation as the best course of action available". Zaltman (1973, referred to in Reunis, 2007) recognized organizational adoption process using a two-phased approach. The first phase, primary adoption, is the decision to adopt an innovation on an organizational level. The second phase, secondary adoption, is when the organizational members in an implementation stage of the innovation decide to adopt it. This two-phased approach can be viewed in light of change acceptance. Primary adoption relates to imposing a new system on the organization, whereas secondary adoption relates to end-user uptake, which has been discussed in earlier chapters. In the first phase, the important factor is to make the organizational level accept the change. In the second phase, even though potential users have accepted the change, it will not necessarily mean that they will adopt the system.

Returning to Caniato et al. (2012), the framework they propose is divided into three stages: preimplementation, implementation, and post implementation. The pre-implementation phase addresses the identification of the goals of the project before selecting the appropriate functionalities to ensure achieving those goals. During the implementation phase, the functionalities (e-procurement elements) selected in the previous phase are introduced within the company. Furthermore, Caniato et al. (2012) argue that within this phase, the implementation should be frozen until the desired benefits are verified being achieved. They also highlight that some possible changes in management might be needed in this phase. In the final phase, post-implementation, assessment of whether the desired benefits have been attained or not should be the main focus. The implementation model Caniato et al. (2012) propose is quite similar to Lewin's change model with a clear diagnosis and an analysis phase, which are Lewin's first two stages. In order for managers to ascertain easily what phase they are currently in, we elaborate on the three phases and interpret the characteristics of each phase. Furthermore, upon having established the project phases and characteristics in the framework, the process of mapping CSFs onto the phases could begin.

**Pre-implementation phase:** Caniato et al. (2012) find that during pre-implementation, the objective is to decide is what elements the company should focus on, and how these should be managed. This phase will typically include the scope of the project, design and development, strategy formulation, choosing e-procurement functionalities, and benefit identification. For example, among all benefits, the company must understand and choose which of the potential benefits it wants to focus on. Such benefits are automation of non-value-added activities, centralization of tactical and strategic activities, and information sharing (Caniato et al., 2012). This phase relates to

work and planning needed before one can initiate pilot projects and system roll-out to end-users. Munns and Bjeirmi (1996) support this notion by stating that sufficient project planning in the early phase is critical to achieve success.

**Implementation:** During this phase, the system and functionalities selected are introduced to the company in order to be used in the day-by-day activities. Pilot projects will typically be the first step in introducing the system to end-users (Caniato et al., 2012). This will allow for testing of the system and its functionalities, gathering feedback from users, correction of any problems encountered etc., before rolling out the system to all end-users. According to Caniato et al. (2012), this phase also concerns actions needed to achieve the goals of the implementation. Employee training and people involvement, especially top management commitment, were found to be crucial factors for successful implementation. As mentioned above, the authors suggested freezing the implemented solution to verify achievement of benefits. Adoption has to be measured, and incentives linked to individual targets. Furthermore, the authors noted that change management was an important aspect during this phase.

**Post-Implementation:** According to Caniato et al. (2012), this phase concerns benefit assessment, quantification of user satisfaction, and possible modification of misaligned functionalities. This phase is reached when pilots are finished, supplier catalogues and systems are integrated, and the system has been rolled out to all end-users for day-to-day use. Caniato et al. (2012) found that adoption of the system was vital to achieve expected benefits in this phase, and that higher adoption led to larger benefits. This notion is supported other authors as well, such as Arbin (2008a) and Reunis et al. (2006). Although measurement was found to be especially important during this phase, the authors stressed that measurement systems must be implemented already during the pre-implementation phase, and monitor achievements throughout the project to assure success. After having introduced most of the vital parts concerning the implementation phases of the framework, next section will elaborate on the critical success factors underlying the framework.

#### 2.5 Critical success factors in the framework

Vaidya et al. (2006) state that previous research on CSFs in e-procurement is sparse, and that there is a need for much better understanding of CSFs concerning e-procurement implementation. Subsequently, Vaidya et al. (2006) employ a literature survey of practitioner material to capture practitioners' perceptions of e-procurement practices. The result is eleven identified CSFs, with attributes. A more recent and extensive study by Panda and Sahu (2012) covers 28 different research-studies identifying CSFs in an e-procurement context. The authors extend the work of Vaidya et al. (2006) by finding literature support for the same eleven CSFs and by adding attributes having impact on e-procurement project outcomes. Furthermore, Panda and Sahu (2012) and Caniato et al. (2012) request a tabulation of the CSFs in terms of e-procurement stages, as the CSFs lack a project execution context like project phases.

Clark et al. (2012) attempt to address a request by Vaidya et al. (2006) for in-depth case studies to validate the eleven CSFs. Clark et al. (2012) use these CSFs to analyze a large and successful e-procurement project for the State of Arizona. More specifically, they analyze how efforts of the project team relate to the different CSFs, what obstacles a focus on the CSFs are able to overcome, and what benefits are realized by using the CSFs. The project initiated incremental implementation of an e-procurement solution in June 2009. By July 2011, all state agencies had successfully implemented all the phases of the project on time and within budget. Some of the benefits realized was increased transparency and competitiveness, leading to expected cost reduction in the range of 5-20% on a \$6 billion state spend (Clark et al., 2012).

The findings of Panda and Sahu (2012) and Clark et al. (2012) were used to support and enrich those of Vaidya et al. (2006) in our pre-diploma thesis. We chose to enrich the framework of Vaidya et al. (2006) as it was well established. Furthermore, as mentioned introductorily, we explored two different streams of literature regarding individual information system adoption and use. These theories are 1) adaptive structuration theory (AST), and 2) The Unified theory of acceptance and use of technology (UTAUT). Both theories have previously been adapted to analyze e-ordering adoption in case companies. Arbin (2009) adapted AST to an e-ordering context through her Ph.D. dissertation. Reunis (2007) adapted UTAUT to an e-ordering context through his dissertation by looking at how influence tactics affect adoption. These dissertations were analyzed in our pre-diploma thesis, and attributes were extracted from their findings also to enrich our framework.

The eleven CSFs by Vaidya et al. (2006) are explained briefly below in subsections 2.4.1-2.4.11. The approach we employed to enrich the factors by Vaidya et al. (2006) will also be exemplified briefly only for the first factor, End-user uptake and training, to illustrate the method we used for the eleven CSFs. The same goes for the approach used to map the CSFs onto the three project phases and using change management as a backdrop. This process was comprehensive and is not the focus of this master's thesis. The result of the enrichment process is for convenience shown in Table 1 below. Each headline is one CSF, coinciding with those in the framework above in Figure 5. The paragraph below each headline contains all the attributes, and increase managerial implications by indicating what each CSF consists of and important aspects to consider.

## **3.0METHODOLOGY**

The research questions must be considered for choosing an appropriate research design and research method. Choosing research method is also dependent on the hypotheses. As already indicated by the research questions and hypotheses, an empirical survey is implied as a proper approach to comply with the aim of this master's thesis. As mentioned in chapter 1, this aim includes partially validating the framework by investigating the large base of end-users and their beliefs and attitudes towards e-procurement. The following sections will entail justifications for choosing research design, research method, quality criteria, and finally an elaboration on potential statistical data analyses 3.1 Research design and research questions

Bryman (2012) defines research design as the framework that guides the process of collection and analysis of data. The decisions and choices made in the research process are reflected in the choice of research design. Moreover, according to Bryman (2012), causal connections between variables, and generalization to a larger group than the often downscaled one which is investigated, are two aspects affected by the choice of research design. The first aspect concerning variables should be addressed more closely. As Bryman (2012, p. 48) defines it, "a variable is simply an attribute on which cases vary". Often deemed as people, however, cases may also include everything from a household to an entire nation.

Among several research designs, Bryman (2012) highlights case studies as a research design. Yin (2014) elaborates on different components that are important for developing a case study design, and one of these components is concerning the research questions of the study. Furthermore, this component is strongly linked to which method of data collection that should be used since the research questions steer the researchers somehow to which method to be chosen. Research questions in terms of "how" or "why", according to Yin (2014), infer that a case study may be appropriate, whereas "who", "what", "where", and "how much/many" infer a survey. By recapping our research questions, they are in the form of "what/which" and "how much", hence indicating a research design comprising of a survey is favorable.

Survey research comprises, according to Bryman (2012, p. 60), "[...] a cross-sectional design in relation to which data are collected predominantly by questionnaire or by structured interview on more than one case [...] a single point in time in order to collect a body of quantitative or quantifiable data in connection with two or more variables [...], which are then examined to detect patterns of association." In other words, a survey research design is by Bryman's (2012) definition is subjected to be a cross-sectional design where data is collected at one occasion. Mills et al. (2009), on the other hand, introduce a research design called case study survey research. The definition of case study survey research design is: "[...] a research design in which a survey is administered to a case, either a small sample or an entire population of individuals, to describe an aspect or characteristic of that population" (Mills et al., 2009, p. 125). The definition is somewhat alike to Bryman's (2012) definition of survey research. However, the notion of a case distinguishes the definitions. It is appropriate to follow the case study survey research design because the gained insight by the sample of the case is aimed to assist the case company. Furthermore, we argue that St. Olav's has a central position in thesis, and some of the hypotheses regarding group differences are heavily influenced by the findings of the exploratory case study of the pre-diploma thesis. Mills et al. (2009) also state that case study survey research design also can entail a longitudinal design, which also enables collecting data at more than one point in time if desired. This is appropriate in our case as this thesis is a continuation of the pre-diploma thesis.

The advantages of this research design, according to Mills et al. (2009), are firstly its usefulness by allowing the researcher to sample a large number of people within a case both economically and quickly. Secondly, the design enables sampling individuals that are not necessarily in close proximity to the researcher. Thirdly, it allows information to be gathered either over a period of time or at one point in time. However, Mills et al. (2009) point out some drawbacks to this research design being that survey data are self-reported information, and therefore only reflect what individuals think, or believe they should report at the specific point of time, for instance, the questionnaire is being completed. Moreover, as there is no manipulation of conditions, the research design cannot be used to address causality between relationships to any degree of certainty. The individuals' honesty and willingness to participate are two important aspects influencing the validity of the information gathered. On the other hand, there are some steps that can be taken in order to minimize the effect of these drawbacks, and these will be addressed in the following sections.

Although it has only been mentioned implicitly, the research strategy of this thesis is of a quantitative nature. Bryman (2012) underlines other research designs that also allow for quantitative strategy in addition to case study and cross-sectional design, and one of these are comparative designs. A comparative design could also have been employed in this thesis, which allows assessing two or more populations (i.e. multiple companies) at one point in time, according to Bryman (2012). However, given the main focus on St. Olav's and their specific context and current situation in an e-procurement implementation, finding another similar public hospital for reference is challenging. Therefore, employing the case study survey research design is deemed as an appropriate approach.

## **3.2 Research Method**

Mills et al. (2009) state that the most common instruments to collect data when employing a case study survey research design are either questionnaires or interview guides. Considering that interviews with a large group of endusers in order to collect data is out of the question because of time and other resource constraints, a self-completion questionnaire is the relevant method. Administering this instrument to a large sample can be done both efficiently and economically when considering the option of online surveys. Furthermore, this enables gathering a potential large response set that can be employed for testing the hypotheses and provide insight and understanding to the research questions.

## 3.2.1 Survey development

Before the research instrument could be developed, some decisions had to be made regarding which of the CSFs to address in the questionnaire and which of the implementation phases to focus on. Eleven CSFs are intuitively too many to investigate in one questionnaire as they all consist of several attributes that each demands at least one question item. In addition, it also makes sense that end-users cannot relate to all of the CSFs given that the framework is aimed at managers. Because of the implementation phases in the framework, this potentially gives a second dimension to the investigated CSFs that the respondents need to consider when completing the survey. Nevertheless, St. Olav's is deemed to be in the implementation phase, as mentioned as one of the limitations of this thesis in section 1.4. As the case company cannot yet be placed in the post-implementation phase since the characteristics (fully integrated, pilots finished, adoption of the system, etc., cf. Figure 5) of this final phase are not yet established at St. Olav's. Including this final phase in the survey is not sensible because the end-users have to relate to potential future events. Moreover, including the first phase, pre-implementation, in the survey is not sensible either as it is easier for the respondents to relate to present issues than previous. However, one may argue that some of the respondents can perceive themselves to be in either one of the three phases, but the phases are mostly aimed at the project as the whole, not on an individual level. Overall, the investigated project phase of the survey is the current implementation phase, leaving the CSF, security and authentication, out of the question of being explored. This leaves us ten possible CSFs to be investigated. Considering that the framework is to be validated in terms of the end-users' point of view, CSFs were partially selected in terms of what these respondents may have opinions and beliefs about. Five criteria were employed for selecting which of the CSFs and which of their interdependent attributes to investigate, and are as follows: CSFs that are relatable to end-users. Feasibility, i.e. whether it is possible to measure the CSF and the attributes in a survey. The CSF's possible link to the different user groups (the hypotheses). The number of attributes to be investigated should be at least two for each of the selected CSFs. To which further investigation on a CSF may be useful to St. Olav's.

Being relatable to end-users was an important criterion for the chosen investigated CSFs and attributes. Although this criterion is somewhat similar to the following criterion, feasibility is more specifically tied to the survey itself. For instance, if we were to investigate the CSF business case and project management in the survey, measuring the attributes return on investment and total cost of ownership, perhaps would not be feasible being explored in a survey. The third criterion was important in order to investigate attributes that could be linked to user groups. Moreover, the fourth criterion emphasizes that at least two attributes should be included of each investigated CSF. This is because indications of a CSF's overall importance are of greater utility when investigated. Four CSFs were selected based on these criteria: end-user uptake and training, change management, re-engineering the process, and e-procurement implementation strategy. The argumentation of selecting these CSFs based on the criteria is presented below. The remaining CSFs were not seemingly relatable to end-users as opposed to the investigated four.

**End-user uptake and training:** This CSF and all of its attributes are intuitively clearly relatable to endusers. Moreover, by having opinions and beliefs about matters concerning their role in an e-procurement context, all of the eight attributes can seemingly be captured in question items in a survey with end-users as the respondents. The different user groups are also linked to the hypotheses via the research questions, and by testing the respective hypotheses, insight may be gained regarding this CSF's relevance. Although not all of the attributes are specifically hypothesized (for instance in-house training and on-demand training), the results may be useful to St. Olav's. As already elaborated on in chapter 2, adoption by end-users is critical when it comes to information systems such as eprocurement tools. By investigating this CSF, we aim to aid the case company with knowledge regarding end-user uptake, which may prove to be helpful when St. Olav's is going to implement SAP. In addition, the insight is also likely to be of utility value regarding the current EP implementation.

**Change management:** In this CSF, most of the attributes are aimed at a managerial perspective. Nevertheless, many of the attributes can be measured indirectly in terms of end-users' point of view. Three attributes

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of this CSF strike as directly relatable to end-users, and these are communication to key stakeholders and peers, organizational resistance, and irreversible changeover to e-procurement. In other words, it should be possible to translate these attributes to question items. However, as an irreversible changeover to EP is not yet the case at St. Olav's, it may be more cumbersome to capture this attribute in a survey than the first two attributes since the questions will be more of a hypothetical nature. Furthermore, group differences of the first two attributes are captured by hypotheses H5 and H6, whereas the third, irreversible changeover to EP, is not hypothesized. Regardless of this, Irreversible changeover to EP is of high interest for St. Olav's as the future transition to SAP implies that other channels than ordering using the selected electronic system will be discontinued. Therefore, examining this attribute in addition to organizational resistance more in depth may give indications to St. Olav's of how well employees will handle this transition.

**Re-engineering the process:** As with the previous CSF, most of the attributes of re-engineering the process are aimed at a managerial perspective. However, three attributes are seemingly directly relatable to the end-users in addition to being translatable to question items, and these are previous work/order routines, transparency improvements, and compliance with purchasing procedures and standards. We were not able to find theory that supports any group differences among the end-users regarding this CSF. However, investigating the current views and reflections on these topics in lack of hypotheses may still provide useful information to St. Olav's. The reason is that it can aid the consecutive implementation of e-procurement as well as SAP.

**E-procurement implementation strategy:** For this CSF as well, most of the attributes are more relevant in a managerial setting. However, there are some attributes that may be measured in terms of the end-users' point of view. Two attributes strike as more or less directly relatable to end-users, which are preferred supplier and relationships with suppliers. In addition, these attributes are linked to possible group differences in hypothesis H8. Investigating end-users' perspective on suppliers may prove useful to St. Olav's when end-user preferences are replaced with supplier contract agreements to a larger extent. By having information on this subject in terms of possible group differences, St. Olav's can be prepared to a greater extent on how to handle this coming transition.

## 4.0 DATA ANALYSIS

## 4.1 Quality criteria

According to Bryman (2012), three criteria are important in order to assess the quality of quantitative research, namely reliability, validity, and replication. Following, the main types within each quality criteria for evaluating social research are presented. Some of these types will not be further investigated as they either are not relevant or in the scope of this thesis, mostly caused by time and other resource constraints.

**Reliability:** Bryman (2012) refers to reliability as the consistency of a measure of a concept, and states that reliability can be divided into three sub categories for deciding whether a measure is reliable. Stability is the first of them, and this refers to which degree a measure is stable over time. The aim is to assure that results relating to a measure do not fluctuate over time. By choosing a longitudinal case study survey research design instead of one point in time, it would have been possible to assess stability. However, due to time constraints this was not in the scope of this thesis.

Internal reliability is the second of the sub categories, and addresses to which degree the scale or index that is employed is consistent with the indicators that constitute it. Furthermore, this includes to which extent the respondents' scores on one indicator is related to their scores on other indicators. Internal reliability applies to multiple-item measures, which for instance are surveys consisting of questions measured by a Likert scale. Generally, when using a Likert scale, each respondent's answers aggregated form an overall score. When this is the case, there exists a possibility that the indicators do not relate to the same thing, i.e. lack coherence. It is necessary that the indicators are related to each other to prevent that some of the items are indicative of something else (Bryman, 2012). A split-half method is commonly employed as a test to assess the internal reliability, where Cronbach's alpha is the most used test. Moreover, a computed alpha value of denotes perfect internal reliability and 0 denotes no internal reliability. However, the alpha value may also be negative, which may, for instance, imply wrongly coding of one or more items. A rule of thumb is to aim for an alpha value higher than 0.8, according to Bryman (2012).

In a meta-analysis by Peterson (1994), numerous recommended reliability levels are assessed of which below 0.6 is regarded as an unacceptable level. However, the range between 0.5 and 0.6 can also be regarded as fitting for preliminary research (Nunnally, 1967, as referred to in Peterson, 1994). Moreover, George and Mallery (2003) suggest that a Cronbach's alpha in the range 0.6-0.7 is questionable. Categorizing the research in this master's thesis as preliminary is reasonable considering this is the first attempt to validate our framework. Therefore, the lowest acceptable value of Cronbach's alpha is set to 0.6, although in the lower region. Furthermore, an important property of the reliability measure Cronbach's alpha is that the number of items that are included in the calculation affect the

alpha value positively (Peterson, 1994). In other words, wrongly including too many items in a reliability analysis may give an incorrect high alpha value.

Whether our survey exhibits internal reliability or not is determined by performing reliability analyses on the sets of question items of the four investigated CSFs' attributes. If the Cronbach's alpha value is lower than 0.6, actions must be taken in order to assure internal reliability of the attribute(s) in question. Inter-observer consistency is the third of the sub categories for assessing reliability. As the name may indicate, this applies to research methods such as structured observations or structured interviews when there is more than one observer (Bryman, 2012). In order to assess that the observers interpret mutually and consistently, different actions and precautions can be made. However, as our method of data collection is a survey, inter-observer consistency only applies to the interpretation of the question items of the survey to which the respondents' responses are in free text (for instance, SRCord and ReasonNot in Appendix A). Ruling out that these responses are to be included in the testing of the hypotheses, inter-observer consistency is not assessed in this master's thesis. The responses to the free text question items, on the other hand, are included to give a demographic overview.

Validity: Validity is primarily concerned with the integrity of the conclusions a piece of research yields (Bryman, 2012). There are different types of validity that address this quality criterion. Following, the relevant types will be presented. Face validity concerns whether the measure reflects the content of the concept or not, according to Bryman (2012). Establishing face validity may be done by asking people, preferably with experience, to act as referees on the matter whether the concept is reflected by the measure (Bryman, 2012). In our case, assuring face validity is reflected upon the pilot test period, where both third parties and end-users at St. Olav's were included. The level of face validity may be considered medium, as there were some flaws to the pilot testing. Firstly, as we are attempting to measure concepts (the attributes of the four CSFs), knowledge on this matter is important to have a saying whether the question items of an attribute are consistent. The group of third parties, except our supervisor, was lacking this knowledge, and input on whether question items are consistent did not surface. Despite this, wording on numerous question items were reviewed, redundancies removed, and the content of the information pages was revised, all because of the reviewing with the third parties. Secondly, the pilot test with the three test subjects could have been done differently, as mentioned in subsection (3.2.3). Allowing the individuals to complete the survey once without any form of interaction before taking it again, but the second time engaging in a dialogue with them, could have resulted in some improvements. For instance, we would have been able to track their time for completion. In addition, the setting of completing the survey the first time would have been more natural to them than the approach we chose. Still, our approach proved to be of good value as the test subject could share their insights and concerns at any point they themselves felt appropriate.

Concurrent and predictive validity deal with employing a criterion that is relevant to the concept in question (Bryman, 2012). Typically, a golden-standard constitutes this criterion to which the results of the measure are compared with. For example, if a new test designed to measure mathematical aptitude was given to a group of students, a typical way to evaluate concurrent validity is to correlate the new test with an already established math test developed by professors. If the criterion, the established math test, is employed contemporary, it is to determine concurrent validity. However, if the criterion is employed after a certain point of time, it is to determine predictive validity, i.e. whether the new measure has a predictive ability (Bryman, 2012). Addressing concurrent and predictive validity, on the other hand, is not in the scope of this thesis. One of the reasons for this is that finding an established test (a golden-standard) that contains the same CSFs and attributes is not possible, which inhibits the opportunity to address these types of validity.

Construct validity concerns whether a measure that is supposed to denote a concept reflects the concept in question or not (Bryman, 2012). Deducing hypotheses from theory that are relevant to the concepts is often how researchers are encouraged to estimate construct validity. However, determining construct validity by a single study is not possible, according to Peter (1981). Furthermore, in order to determine even a tentative construct validity, it is required that a series of validity studies and reliability studies are conducted (Peter, 1981). Considering this is out of the scope of this thesis, determining construct validity is left to potential further research.

External validity concerns generalizability, i.e. whether the results of a study can be generalized beyond the context of the research (Bryman, 2012). Lucas (2003) underlines that external validity concerns generalizability to theory, and hence external validity is closely tied to construct validity. This can be illustrated by the quote: "Because theoretical concepts are never measured directly, and because generalization can only occur through applying findings to theoretical concepts, measures in any study must relate to each other consistently with theoretically derived hypotheses for the study to have external validity." (Lucas, 2003, p. 248). Therefore, in order to ensure external validity, the level of construct validity plays a crucial role. In addition, according to Lucas (2003), the situation designed to test the theory must be relevant to the theory, the level of replicability (see subsection 3.3.3), and consistency between the

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theory and the observations (i.e. internal reliability) are important conditions for ensuring external validity. Moreover, choosing either convenience and other non-probability sampling or probability sampling does not affect the ability of generalizing across either populations or settings. However, Lucas (2003) states that if generalizing to the specified larger population is the intention, probability sampling can increase the external validity. As mentioned in subsection 3.2.3, also non-response can influence the level of external validity. Therefore, addressing potential bias due to non-response must be done in order ensure that generalizability is not negatively influenced. As external validity is dependent of multiple aspects from reliability, validity, and replication, the discussion of this quality criterion is left until section 6.2. However, it is worth mentioning that omitting to address construct validity affects the external validity of this thesis negatively. Nevertheless, considerations regarding generalizability may still be made, but with some caution.

**Replication:** Replication, and inherently replicability, deal with the research's capacity of being replicated (Bryman, 2012). In order to eliminate the chance that a research is undermined due to the researchers' potential biases, researchers tend to be highly explicit about their procedures, according to Bryman (2012). Accordingly, objectivity is a key ingredient, especially in social research as the researcher's values and expectations can influence and color the results of a study.

Regarding the replicability of this thesis, it is attempted to keep the level of detail to a high degree. Specifically, by reporting relevant underlying statistics of the analysis, important decision-making, and considerations of the data, a replication of this study should be possible in the future. As with external validity, we will return to replication in section 6.2.

## 4.2 Statistical analysis

In this section, we will present briefly some approaches to the statistical analyses in this thesis. However, in order to prevent going into too much detail in this section, some further description of the chosen approaches is left until section 4.1 and 5.2. Following, the desired data analysis approaches for hypothesis testing are presented before moving on to a description of the alternative approach, namely exploratory factor analysis.

## 4.3 Data analysis

The chosen tool for statistical analysis is IBM SPSS Statistics version 22. Using this rather advanced software allows for managing responses and variables, analyzing data by, for instance, performing reliability tests, analyses of variance, etc. in a systematic way. Before moving on to the results acquired by using SPSS and discussing these in light of the hypotheses in chapter 4 and 5, some steps have to be addressed first. The data for the three versions of the survey were exported from SelectSurvey as readable files to be used in SPSS. The three data files were merged into one with all of the 306 responses. In order to have the ability to assess their origin, a new population variable was added to track each case's (response) originating data file. As all of the variables were named vN (where N is an integer starting at 1), all variables were assigned new names in order to readily understand each variable's nature either it was demographic or in connection to either one of the investigated CSFs. The label of each variable was also changed to contain the English translation to prevent including a second language in the analysis. Moreover, since some variables were constructed as reverse items, cf. subsection 3.2.2, recoding of these variables was necessary in order to make sense of the scoring on these variables. For instance, scoring 5 (strongly agree) was changed to 1, 4 to 2, and so on. The variable names and labels are included in Appendix A in addition to the original Norwegian question items. In addition, all recoded variables are marked with an asterisk before the variable label.

`In order to assess potential group differences, a new variable, vGroup, was added to categorize each case in one of the predicted four groups of H1 based on their response to question item PRCNTvis and FUTuseVis (see Appendix A). Due to filtering, PRCNTvis was only displayed to Visma-users and FUTuseVis only to respondents that had not used Visma. If a respondent replied that he or she only used Visma to complete orders (100% Visma use), he or she would end up in group 1 of the four groups. If the respondent replied less than 100% but more than 0% to the same question item, he or she would be categorized in group 2. Furthermore, if a respondent replied that he or she is projected to use Visma in the nearest future, he or she was categorized in group 3. If the reply to this question item was "no", or that the respondent did not know whether he or she was going to make use of Visma, the respondent was categorized in group 4. The reasoning behind categorizing respondents that do not know whether they are going to make use of Visma in group 4 is that we find it rather unlikely that they are projected to use Visma if they have not received any information. We had to include this response category for potential respondents that do not know what Visma is. This means that group 3 may potentially be a bit larger while group 4 a bit smaller.

The desired analysis approaches consist of descriptive statistics to show the distribution and demographics of the respondents, analysis of variance (ANOVA) to assess differences across more than two groups, independent t-

test to test differences in means when there are only two groups, and running different tests in order to assure that the requirements of the different analysis approaches were met.

The aim of the one-way ANOVA is, according to Ho (2014), to assess whether the means of more than two independent groups differ. By this notion, it is therefore a relevant statistical approach to test the hypotheses concerning either the user groups or age. One-way ANOVA is also known as an extension of the t-test (only two independent groups), and the statistical assumptions of the two approaches are similar. Ho (2014) states that the requirements for ANOVA are that there can only be one independent variables, which should consist of more than two groups, and that only one dependent variable can be tested in each analysis. Furthermore, there are two underlying assumptions of ANOVA. The first one is normality, i.e. that the dependent variable is normally distributed and the second is homogeneity of variance, i.e. that the groups have close to equal variance on the dependent variable (Ho, 2014).

Normality may be checked by Kolmogorov-Smirnov and Shapiro-Wilk tests, by statistical z value for the skewness and kurtosis, and visually by normal and detrended normal Q-Q plots, according to Ho (2014). However, Field (2013) advocates that because of the central limit theorem when a sample is large, significance tests such as Kolmogorov-Smirnov, Shapiro-Wilk, and z-tests will not be of much use since they will almost exclusively show a trend towards a normal distribution. In fact, according to Field (2013), if normality regardless is to be assessed using significance tests, the normality plots ought to be addressed as well. Visually, the normal Q-Q plot should show the data distribution falling more or less on the diagonal and the detrended Q-Q plot should show clustering of the distribution around the straight line with no pattern for normality to be assumed (Ho, 2014).

Homogeneity of variance is typically tested by the Levene statistic (an F-value) with the corresponding level of significance (Ho, 2014). As with the flaw pointed out for the significance tests to check normality, Field's (2013) argument also applies for homogeneity of variance, meaning that large samples almost exclusively do not violate homogeneity of variance. However, when the group sizes are not equal, homogeneity of variance should be assessed (Field, 2013).

#### 4.4 Alternative data analysis

Using ANOVA to analyze group differences on the different attributes, i.e. test the hypotheses, is contingent upon the attributes having a satisfactory level of Cronbach's alpha, i.e. being internally reliable, in order for the analysis to make sense. Since we developed the survey ourselves, there is chance that the question items are more relatable to other concepts (covered by our survey as either included attributes or concepts that are not addressed). Therefore, addressing this potential issue is important for hypothesis testing. Exploratory factor analysis (EFA) is a promising candidate if the attributes fail to fulfill the requirement level of Cronbach's alpha at 0.6. The reasons of why performing an EFA, according to Field (2013), is to, for instance, either understand the structure of a set of variables by the variance they commonly share or to reduce a data set to a more manageable size without losing too much of the original information. A combination of these two causes constitute a good reason for why choosing EFA as a contingency plan. However, using EFA as a contingency plan has some drawbacks.

Turning to explorative factor analysis may involve taking some steps away from the initial aim of validating the framework. Additionally, it may involve that some of the specific hypotheses regarding the attributes cannot be tested. This is because it is rather unlikely for the possible extracted factors to consist of the same variables as the attributes if the attributes show a tendency towards low alpha values. On the contrary, the extracted factors may be used to assess group differences and to provide some understanding to the underlying questions of the hypotheses presented in section 2.6. However, the aforementioned relies heavily on the explorative factor analysis resulting in reasonable factors all aiming to measure seemingly appropriate variables.

Among of the requirements for EFA, Ho (2014) states that the sample size should be at least 100 and have at least five times as many cases as variables included in the EFA, although having ten times as many cases than variables is more in the acceptable range. Beavers et al. (2013) underline that there is no consensus on this matter and that, for instance, Gorusch (1983, as referred to in Beavers et al., 2013) and Norušis (2005, as referred to in Beavers et al., 2013) advocate at least 200 and at least 300 cases, respectively, regardless of the ratio of cases to variables. Field (2013) states that if the sample size is greater than 300, factors with few and low loadings (less than 0.40) may still be interpreted. Furthermore, a typical approach to assessing the sample adequacy for EFA is Kaiser-Meyer-Olkin measure of sampling adequacy (KMO). A KMO statistic under 0.5 is not acceptable, a value in the 0.70s is in the middling range, and in the 0.90s in the marvelous range (Field, 2013).

## **5.0 CONCLUSION**

Furthermore, this has led companies to utilize electronic procurement tools in order to make indirect purchasing more efficient and effective. To ensure a successful implementation of these tools, it is advantageous to consider critical success factors (CSFs) capturing important aspects of the implementation. Adoption of the system is one such aspect, critical for achieving planned benefits. Previous research on e-procurement have covered such CSFs to some degree, but this research was not unified into one framework, covering both CSFs and relevant project phases. Based on this notion, as well as being requested by other researchers, we set out to construct such a framework in the pre-diploma thesis. The resulting framework formed the basis for this thesis, and it was introduced in chapter 2. One of the caveats of the framework was a lack of validation. Other researchers contributing with the theories that make up our framework, also called for further validation. The aim of this master's thesis was to remedy this lack of validation, and to assess its relevance for end-users. This was a feasible option considering St. Olav's as the case company, and the available sample of end-users.

Referring back to the main research question "Are different CSFs more or less relevant for different types of end-users in an e-procurement implementation context?". The answer to this is complicated. As mentioned, we set out to validate CSFs from an end-user perspective. Of the four CSFs we attempted to validate, only the CSF End-user uptake and training had all attributes relevant for end-users. The three remaining CSFs Change management, Re-engineering the process, and E-procurement implementation strategy had only a few attributes seemingly relevant for end-users. Therefore, the aim was to indirectly validate these CSFs from an end-user perspective by validating the CSFs' attributes relevant to end-users. Furthermore, as mentioned in section 2.6, we were not able to hypothesize differences for all these attributes as they lacked being previously explored in theory. This led us to develop a survey attempting to find differences regarding the attributes. Figure 13 in subsection 6.1.1 provides an overview of what attributes we were able to measure by using the extracted factors of the EFA. Using these attributes, we were able to find significant differences across sex, age, and the four groups relating to use of Visma. Although we were unable to test the CSFs to the degree we set out to do, we argue that these differences for attributes are enough to infer that the different CSFs are more relevant for some end-users than others. Based on this notion, the answer to the research question is therefore yes.

However, we emphasize the weakness of not finding differences for all the CSFs' attributes, and that the differences found may only be relevant for our specific case company. On the other hand, one may be able to find more differences when looking at other companies. Furthermore, not finding differences can be a strength of the framework, indicating that factors are more or less equally important to all end-users. This can facilitate the implementation as managers do not need to consider end-user differences for all CSFs. We also point out that the framework is comprehensive, as illustrated by the fact that we were only able to look at a small portion of the framework. It was not possible to consider the framework in its entirety due to resource and time limitations, as elaborated on in further research.

Overall, by finding an additional attribute to be added we have seen that our framework has room for improvements. We did also find differences among the end-users as well as well as being able to establish the overall importance of some of the attributes measured. Although many of the hypotheses were inconclusive, we found nothing indicating that any parts of the framework are irrelevant. On the contrary, our findings indicate that the framework is relevant, at least to end-users, and that further research on the framework is appropriate.

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