CHALMERS

Diffusion of Medical Technology in the Fetal Monitoring Industry

A study of ST Analysis and the STAN-method

Master of Science Thesis in the Master Degree Programme
Management and Economics of Innovation

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Gothenburg, Sweden, 2013
Report No. E 2013:048

MASTER'S THESIS E 2013:048

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Chalmers Reproservice
Gothenburg, Sweden 2010

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Abstract

Healthcare is a sector that has undergone significant technological change in recent decades. While benefits are great there are also challenges, not least in the diffusion of innovations. The interplay between technology and healthcare is perhaps most salient in the medical devices industry. Here, innovation is distinguished post-adoption by high and lingering uncertainty, potentially obstructing diffusion. Obstetric care is a sub-sector that particularly benefits from technological advance but has been slow in adopting novelties, especially in the area of fetal monitoring. This area is concerned with identifying and rescuing babies at risk during labor.

This thesis has investigated adoption and diffusion of the fetal monitoring method named the STAN-method, offered worldwide by the Swedish company Neoventa Medical. The company is experiencing great variation in terms of hospitals' enthusiasm toward the method and, as a result, is experiencing difficulties in achieving diffusion. The purpose of the present study is therefore to investigate the nature of adoption and diffusion barriers of the STAN-method and to identify relevant factors for Neoventa when seeking to address these barriers in the future.

In order to achieve the purpose, a phased research process and a comparative design were employed. Initially, a pilot study investigated the nature of barriers by comparing representative Swedish hospitals that have adopted the method to different extents. Following this, a continuation study built upon pilot study findings compares success cases in and outside Sweden and investigated the sales model of Neoventa. The theoretical base of this thesis consists of a framework for diffusion of medical technology and a model for technology marketing, which function as a springboard to generate learnings for Neoventa.

Conclusions drawn in this study are threefold. Firstly, the two most important areas for the company to address when seeking to achieve diffusion were found to be internal influencers in the form of opinions leaders and the actual implementation of the STAN-method in the organization. These two areas had both the largest impact on the adoption process at investigated hospitals and differed the most between successful and unsuccessful cases. Secondly, activities that increase the focus of the company in terms of target customers should positively affect the company's reference-base, which in turn is critical to spread the method among conservative customer segments. Thirdly and finally, Neoventa must deliver the whole product, consisting of training, support, guidelines and scientific credibility, in order to achieve quick and full conversion of hospitals to the STAN-method. A whole product mentality employed in combination with a high degree of focus in choosing target hospitals is likely to contribute to faster diffusion of the STAN-method, driven by a characteristic referencing-behavior of customers in the medical technology market.

Keywords: Innovation Diffusion, Adoption and Diffusion Barriers, Medical Devices Industry, ST analysis, the STAN-method.

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1. Introduction

This chapter introduces the focal company, Neoventa Medical AB and the very purpose of this thesis. Further, a problem analysis is presented along with research questions that have been developed to achieve the purpose. The chapter is concluded with delimitations and the disposition of the report.

1.1 Background

The present study focuses on an innovation in the fetal monitoring industry, which is a subset of obstetric care. The innovation, the STAN-method, is a method and devices that monitor the baby during delivery. The STAN-method is in Sweden enthusiastically accepted by some hospitals and forcefully rejected by others. This thesis specifically focuses on adoption and diffusion of the STAN-method and the associated medical devices.

In recent decades, rapid advances in technology, primarily aiming to increase the quality of care delivered to patients, have revolutionized healthcare (Gerhardus, 2003; Norén & Rosén, 2008; Szczepura & Kankaanpää, 1996). The amount of innovations and their impact on health care as well as on the supplying firms have, arguably, been unprecedented in history, not only in clinical terms but also in economic and in strategic terms (Ghodeswar & Vaidyanathan, 2006). The health sector is still under change and health organizations face large challenges in coping with the constantly changing technological situation (Cohen et al., 2004). The value of healthcare innovations is often large for both patients and health-providing organizations. Patients can benefit in terms of improved health or less suffering while health-providing organizations can increase efficiency and quality of care. However, healthcare innovations have also been described as unique and complex due to potential health risks, regulatory limitations and its inhibiting effect on organizational cultures (Länsisalmi, Kivimäki, Aalto, & Ruoranen, 2006). As understood from this, there exists a large need for innovation in healthcare but challenges are, arguably, prevalent. Not least diffusion of healthcare innovations poses challenges in terms of the influence of social actors, the complicated processes of assimilation and routinization of novelties and the complex nature of the adoption process (Greenhalgh, Robert, Macfarlane, Bate, & Kyriakidou, 2004) which involves actions by individuals, groups as well as organizations (Szczepura & Kankaanpää, 1996).

It is important to distinguish between the concepts of adoption and diffusion. Adoption is a positive result of a decision process where an organization decides whether or not to use an innovation. Diffusion on the other hand, refers to a process of spreading an innovation among members of a social system (Rogers, 1995). One can therefore understand diffusion as a process consisting of many individual adoption decisions. Furthermore, diffusion is a process that occurs both within organizations, or social system, and between organizations.

The interplay between technology and healthcare is perhaps most clearly illustrated in the medical devices industry. A medical device is an article that is used to diagnose, prevent or treat diseases or medical conditions by other means than by chemical reactions inside the human body, distinguishing it from a drug (Fda.gov, 2013). Innovation in medical devices is distinct from innovation in other industries in two prominent ways. Firstly, a high level of uncertainty frequently lingers for a significant period of time after the first adoption of a new device, resulting in a development process that must be continuous. Specifically, this uncertainty typically remains due to a requirement of extensive use before the full effects of a technology in clinical application can be understood. Secondly, extensive feedback mechanisms between users and those who develop new devices are

required to further develop the technology. Feedback mechanisms are crucial since medical devices often require significant clinical use before uncertainties can be truly reduced. Another characteristic of medical device innovations is that they often originate from outside the industry. Well-known examples are lasers, magnetic spectroscopy, ultrasound and the computer, all of which were initially developed for entirely different purposes. In fact, advanced monitoring technologies such as these, embodied in medical devices, are critical for a functioning modern unit of care (Gelijns & Rosenberg, 1994).

One healthcare sector in which medical devices in general, and monitoring technologies in particular, are important, is obstetric care. This sector has in recent decades evolved to rely heavily upon advanced monitoring technologies such as ultrasound and x-rays (Moore et. al, 1990). At the same time, introduction of new advanced technology in this field has been described by researchers as a delicate task (Olofsson, 2003). Accordingly, some areas within obstetric care have been slow in reaping benefits from technological advance. This is particularly the case within fetal monitoring, a subset of obstetric care (Norén & Rosén, 2008). The aim of fetal monitoring is to identify and rescue babies at risk in a timely manner without unnecessarily increasing the use of instruments in delivering them (Norén & Rosén, 2008).

Specifically in fetal monitoring, there are several widely used technologies and methods but little consensus among health organizations, professionals and researchers as to the value of each. The most influential and widely spread method in fetal monitoring is cardiotocography (CTG). CTG continuously records and plots the fetus' heart rate along with the mother's contractions, where changes are viewed as indications of distress. The aim is to identify babies that are short of oxygen and to reduce infant death (Alfirevic, Devane, & Gyte, 2006; Jenkins, 1989). CTG was in the late 1970s widely accepted as a highly beneficial method, but was reappraised in the 1980s due to discovery of limitations. Criticism revolved around low predictive ability, low robustness and premature clinical diffusion (Jenkins, 1989). Despite this, CTG is widely used today. A recent meta-study illustrates continued dispute over alleged benefits (Alfirevic et al., 2006). For example, the study shows there is no statistically significant difference in perinatal (time during and immediately around birth) deaths between using continuous CTG monitoring and using intermittent auscultation, which is another method that involves listening to the baby's heart rate with a stethoscope. Furthermore, the study identifies a correlation between CTG and increases in cesarean sections, which is considered negative. Other important methods in fetal monitoring include fetal blood sampling (FBS), meaning to extract and analyze a blood sample from the fetus' forehead (Alfirevic et al., 2006).

The present study focuses on a medical technological innovation within electronic fetal monitoring: ST analysis. ST analysis is a development of the CTG method. In addition to following the fetal CTG, the ST analysis is monitoring and analyzing a particular wave, the ST wave, of the fetal electrocardiogram (ECG), which is the electric activity of the heart. ST analysis technology is embodied in a portfolio of medical device products, which are clinically applied in the STAN-method. The STAN-method is marketed worldwide by the Swedish company Neoventa Medical AB (henceforward referred to as Neoventa), the focal company of this study (Neoventa.com, 2013). While Neoventa has been successful in some countries and individual hospitals, the company is experiencing challenges in diffusing the STAN-method on the Swedish market. In fact, Neoventa has not been able to sell the STAN-method to a new hospital over the past 6-7 years. The only sold volume in Sweden is to existing customers that need to add or replace another device. This indicates

that Sweden remains a huge challenge for Neoventa (Interview 19). In Sweden, the geographical adoption pattern varies greatly and barriers to adoption and diffusion are experienced in healthcare organizations. More specifically, some healthcare organizations have enthusiastically adopted the STAN-method while others forcefully reject it. Also, some adopters have later abandoned the method, discontinuing their use of ST analysis. This means that there exist different cases where the diffusion of STAN within hospitals has been more and less successful.

1.2 Problem Analysis and Purpose

Difficulties in achieving diffusion, or growth, with an innovation in the marketplace have several consequences for the firm. A technology with large installed base, i.e. the number of units currently in use in the marketplace, is due to its foothold on the market very difficult for competitors to overthrow. Thus, a technology with a smaller installed base is more vulnerable. Moreover, the more users a technology has, the more attractive it becomes (Schilling, 1999). Complex technologies that are used widely often generate additional knowledge, which drives both improvements of the technology itself and of its application areas. For technologies that are not used, such continuous improvements through knowledge generation become challenging, resulting in difficulties to compete with technologies with high market penetration. A further danger is the obsolescence of technology; the firm needs to keep momentum and stay ahead of the next emerging technology. Else, technological leadership is lost, as well as associated profit-margin advantages (Moore 1991, p. 13). Hence, difficulties in convincing a larger and growing number of customers to adopt an innovation can entail competitive disadvantages, especially for firms that provide complex technologies such as Neoventa.

Markets for high technology have been found to be different from other markets in terms of adoption behavior of customers. In these markets, customers frequently look to each other to reassure themselves of a technology's value before adopting. Such reference-based adoption behavior means that a technology that is less able to diffuse on the market may find itself unable to obtain enough referencing customer to diffuse further. Ultimately, it may succumb to other technologies that diffuse more rapidly on the market (Moore, 2002), regardless of technological superiority. In fact, technological superiority has been shown by several authors to be less important when a market chooses dominating technology (Anderson & Tushman, 1990; Lee, O'Neal, Pruett, & Thomas, 1995; Moore, 2002; Schilling, 1999, 2002). The fact that some customers have discontinued their use of the STAN-method means that longer-term competitive consequences are not the only potential consequences. Apparently, barriers to continued adoption, or continued use, also exist within organizations in the shorter term.

Due to these potential consequences, it is important to understand the barriers to adoption and diffusion of the STAN-method that Neoventa is experiencing, and what factors are important to address them. Knowledge in this area is clearly important for the long- and short-term success of Neoventa as a firm, and the STAN-method as a technology.

The purpose of this thesis is therefore to understand the nature and implications of experienced barriers to adoption and diffusion of the STAN-method. The purpose is further to identify what factors are relevant for Neoventa when seeking to address these barriers in the near future.

1.3 Research Questions

To achieve the purpose of this thesis, the problem area was initially explored with a pilot study. Based on its results, a continuation study that addresses one main research question and two sub-questions was developed. Below follows a presentation of the questions and an explanation of the overall aim of each.

> *Pilot Research Question: What barriers to adoption and diffusion of the STAN-method exist, and what is their implication for Neoventa in spreading STAN?*

This pilot research question intends to identify underlying barriers that cause the large variation in adoption patterns between hospital groups, as well as their implication. Such an understanding will be a requirement for Neoventa when formulating any future actions to address current difficulties. This question is answered by a pilot study focusing on the Swedish market. It includes four hospitals that each represents a different group exhibiting certain adoption patterns on the market; namely, one hospital that has enthusiastically adopted STAN, one hospital that has shown hesitation towards the method, one that has abandoned it entirely after adoption and, finally, one that has never adopted STAN.

In the pilot study, it was understood that the STAN adoption pattern varies greatly among studied hospitals, which will henceforth be referred to as either successful or unsuccessful. Successful cases are hospitals that have enthusiastically adopted the STAN-method while unsuccessful cases refer to hospitals where STAN has met resistance resulting in little or even no usage of the method. The pilot study results enabled formulation of the following main research question.

> *Main Research Question: What are the differences between successful and unsuccessful cases in terms of adoption of the STAN-method, and what can be learned from these differences, in order to overcome barriers to adoption and diffusion of the STAN-method at hospitals in general?*

The main research question first aims to identify and analyze differences between successful and unsuccessful cases. Further, it intends to generalize findings into learnings, which also requires an understanding of Neoventa's sales model. Learnings are aimed to be of use for Neoventa in their future efforts to overcome adoption and diffusion barriers at hospitals in general, i.e. at current unsuccessful cases as well as when approaching new customers. In order to answer the main research question, the following two sub questions therefore first need to be addressed.

> *Sub Question 1: How have barriers to adoption and diffusion of the STAN-method previously been overcome in individual success cases?*

This research question aims to investigate how the identified barriers in the pilot study have been overcome in cases where STAN has been enthusiastically adopted.

> *Sub Question 2: What is Neoventa's sales model for spreading STAN?*

To overcome barriers to adoption and diffusion, it is not only important with an understanding of the customer' perspective, it is also important to consider how Neoventa is currently selling STAN. Therefore, this question aims to investigate Neoventa's sales strategy and processes, here referred to as sales model. This question covers both the sales process and Neoventa's overall experience and perspective on sales.

1.4 The Focal Company: Neoventa Medical AB

Neoventa is a Swedish medical device company with headquarters in Mölndal and subsidiaries in Paris, France and in Boston, USA. The company was founded in 1997 and develops, manufactures and markets the STAN-method; going to market with both a direct sales force and a network of distributors. Core competencies of Neoventa are in monitoring during childbirth using a combination of CTG and ST analysis. These competencies are viewed by the company as enablers in the delivery of solutions that improve quality of care as well as efficiency for their customers; healthcare organizations that deal with childbirth. Ownership of Neoventa is held by Investor Growth Capital, CapMan Life Science and SEB Venture Capital. Since the launch of the STAN-method in Europe, over one million babies have been delivered using it. There were just under 2 000 STAN units installed worldwide in the beginning of 2013. Of the approximately 600 hospitals or clinics that have adopted STAN worldwide, 500 are in Europe. However, while Neoventa has high penetration in some countries such as Norway and Belgium (both over 90 percent), the company has not experienced any significant success in the large European markets such as France or I the United States. The home market of Sweden is divided in its enthusiasm for the STAN-method (Neoventa.com, 2013; Interview 19).

The company describes its business within three areas. The first area is constituted of providing the product Stan S31, a monitoring device with a display capable of CTG and, with an upgrade, to ST analysis in combination with CTG. The S31 monitor is the core of the STAN-method. The second area of business is to sell disposable equipment that is used clinically together with the S31 monitor. This includes the fetal scalp electrodes named Goldtrace® and GoldtracePlus®, designed for the high signal quality requirement of ST analysis. GoldtracePlus® is distinguished through the addition of a patented solution, Click Release®, for guaranteed correct application of the electrode on the baby. Neoventa also offers an array of sensors placed on the patient during birth as a part of their disposable equipment business. The selling of those supplementing products is very important part of Neoventas business; since the sales cycles of STAN devices are as long as 12-18 months, Neoventa is highly dependent on additional products with shorter sale cycles (Interview 19). The third business area is education, under the name of Neoventa Academy, which is an education package revolving around both CTG and ST analysis and that is performed online or offline and includes a certification upon completion (Neoventa.com, 2013).

In the fiscal year (FY) of 2011, Neoventa had a turnover of 35 955 KSEK and a net income of -18 968 KSEK. The solidity of the company was 79.45 percent. The number of employees at the end of FY 2011 was 18 (Affärsdata, n.d.)

1.5 Delimitations

The purpose of this thesis, as presented previously, is firstly to understand the nature and implications of experienced barriers to adoption and diffusion of the STAN-method. The aim is not to investigate the STAN-method in detail and delve into each of the products that comprise the STAN-method. Thus, the present study will explore and analyze barriers to adoption and diffusion on a method- rather than on a component level.

In order to understand what barriers to adoption and diffusion that exist, a number of hospitals were investigated during the course of this study. These hospitals were chosen depending on the level of STAN-adoption. In fact, hospitals that had enthusiastically adopted the method are viewed as success

cases and those that forcefully reject it or have only adopted it on a small scale are viewed as unsuccessful. This means that many other factors were not controlled during the choice of cases to investigate. In turn, this results in a limitation regarding hospital characteristics such as working culture, organizational structure and functional areas of operation. Moreover, the population of available hospitals in each category of success resulted in additional limitations. The number of unsuccessful cases in Sweden and abroad was large, meaning that representative cases had to be selected. In the initial phase of the research, this large number of cases was grouped according to Neoventa's own knowledge about which groups of unsuccessful cases exist. Regarding success cases, the number was much smaller. In fact, this number was small enough to make selection straightforward. However, not all success cases were investigated either. Hence, this thesis does not aim to comprehensively study all unsuccessful or successful cases, but to generate understandings based on representative cases from each group.

At each investigated case in the pilot study, several interviews were made in order to elicit as many different opinions as possible. However, all professionals of note involved with STAN were not included. Similarly and further on in the continuation study, a single interview was conducted for each case. This leads to the limitation that not all categories of clinical professionals were covered in all investigated cases. The professional(s) included were moreover working at different positions in the hospitals in question. Hence, this thesis cannot provide a deep understanding of the dynamics of each investigated case in terms of the effect of certain professionals, but rather aims at covering certain aspects of each case's dynamic in terms of STAN-adoption, regardless of which professional that provided the data.

The purpose of this thesis is further to identify which factors are relevant for Neoventa when seeking to address these barriers in the future. It does not aim to provide recommendations on concrete actions that should be taken in light of findings. Such an action-plan requires more detailed knowledge about case hospitals, both those included as well as those not included in this study. However, the identified factors in this dissertation could serve as a base in order to develop further studies leading to more detailed knowledge and such concrete actions being developed.

Finally, the geographical scope is limited to the Swedish market and a few notable success cases abroad that deserve to be included based on exceptionally successful STAN adoption. Focusing on inclusion of cases from abroad, limitations apply to differences in culture, clinical practice and other nation-specific factors. However, a brief investigation was done in order to ascertain the applicability of findings abroad.

1.6 Disposition of the Thesis

Below follows a chapter-wise overview of the disposition of the thesis. Each chapter is described in terms of its purpose and its main content.

1. Introduction

This chapter introduces the focal company, Neoventa Medical AB and the very purpose of the present study. Further, a problem analysis is presented along with research questions that have been developed to achieve the purpose. The chapter is concluded with delimitations and the disposition of the report.

2. The STAN-Method

This chapter describes the STAN-method and its underlying method, CTG. Technical information and conducted scientific research on both methods will be presented. This is done on the one hand to give the reader a broad introduction to the methods as well as their clinical advantages and disadvantages. On the other hand, understanding the methods and their scientific status is also crucial in relation to the purpose of this dissertation, which is understanding adoption and diffusion of the method.

3. Methodology

This chapter presents the methodology of the thesis. Specifically, it describes the choices of research strategy and process, the associated problem-solving approach, the choice of research design, the use of research methods and the choice of sampling approach. The chapter is concluded with a discussion of validity and reliability.

4. Previous research

This chapter presents the historical milestones in the diffusion research field and further examines important developments in the sub-field of diffusion of medical technology. This is followed by a discussion regarding the relevance of previous research for the purpose of this study.

5. Theoretical Framework

This chapter presents the selected theory that forms the basis for the analysis of the continuation study. The theory consists of two parts: a diffusion framework and a technology-marketing model. The diffusion framework intends to analyze the dynamics of medical technology diffusion within hospitals. Further, in order to also understand actions that can be taken by a firm to stimulate diffusion, the influential work in marketing of technology by Moore (1991) is introduced as the technology-marketing model.

6. Exploratory- and Pilot Study Findings

This chapter presents the results from the exploratory- and pilot study. The exploratory study was performed with employees at Neoventa Medical. The pilot study consisted of interviews with key stakeholders at four different hospitals in Sweden. The results are followed by an analysis in relation to the pilot research question "*What barriers to adoption and diffusion of the STAN-method exist, and what is their implication for Neoventa in spreading STAN?"* as well as implications for the focus of the continuation study.

7. Continuation Study Findings

This chapter presents the findings from the continuation study. In the first part, sales personnel at Neoventa give their view of Neoventa's Sales Strategy. This is followed by five cases that illustrate successful adoption and implementation of STAN at five different hospitals. The aim of this chapter is to answer the two sub questions: "*How have barriers to adoption and diffusion of the STAN-method previously been overcome in individual success cases*" and "*What is Neoventa's sales model for spreading STAN*?"

8. Analysis

This chapter presents the analysis of the empirical findings from the pilot- and continuation study in relation to the theoretical framework detailed in chapter 5. The purpose of this chapter is to answer the main research question "*What are the differences between successful and unsuccessful cases in*

terms of adoption of the STAN-method, and what can be learned from these differences, in order to overcome barriers to adoption and diffusion of the STAN-method at hospitals in general?" The chapter is divided in two parts, first successful and unsuccessful cases will be analyzed in relation to the Diffusion Framework. Second, Neoventa's sales model will be analyzed in relation to the Technology Marketing Model as well as the insights from the first analysis.

9. Conclusions

This chapter presents the conclusions of the thesis by answering the pilot- and the main research question. The answer to the pilot research question, dealing with the existence and nature of barriers to adoption and diffusion of the STAN-method, consists of five barrier parameters. The answer to the main research question, dealing with what Neoventa can learn from this study, is presented in terms of three learnings.

2. The STAN-Method

This chapter describes the STAN-method and its underlying method, CTG. Technical information and conducted scientific research on both methods will be presented. This is done on the one hand to give the reader a broad introduction to the methods as well as their clinical advantages and disadvantages. On the other hand, understanding the methods and their scientific status is also crucial in relation to the purpose of this dissertation, which is understanding adoption and diffusion of the method. In fact, this chapter will show that there is a degree of controversy surrounding the STAN-method despite an extensive body of supporting research. Further, it will show that the CTG method is widely used regardless of an extensive body of research casting considerable doubts on the presence of any benefits. This indicates that other factors than technical performance and scientific evidence affects adoption and diffusion of a fetal monitoring method, a critical insight for this study.

Broadly described, the STAN-method is an extension method to fetal monitoring using CTG. It adds ST analysis of the fetal ECG waveform, the electric activity of the heart, to the regular CTG heart rate and contraction measurements. The relationship between ST analysis and the STAN-method is that STAN consists of products and methods that enable ST analysis to be conducted. STAN uses both CTG and ST analysis to provide information on the baby to clinical professionals during labor (Neoventa.com, 2013). Since the STAN-method relies upon CTG, any discussion of the method's value must begin with a similar discussion on CTG. In the following sections, CTG, the STAN-method and their respective current body of clinical evidence will be addressed. Following this review, the impact of the current scientific status of the STAN-method for this thesis will be discussed.

2.1 Cardiotocography (CTG)

CTG is an electronic fetal monitoring method that records changes in the heart rate of the baby externally with ultrasound or internally with a scalp electrode attached to the baby's head. Relations in time between these changes and the mother's contractions (uterine activity), which are documented with a pressure sensor, are recorded. This method then produces a paper, or more recently an electronic, recording of these two measurements, which is then interpreted by clinical professionals. The chief objective is to determine if the baby is suffering from hypoxia (lack of oxygen). A long and severe subjection to hypoxia results in risk of being born with disabilities or a risk of death during or after labor (Alfirevic et al., 2006; Olofsson, 2003). Neonatal (shortly after) death incidence varies between countries, but has been measured at approximately 4/1000 births in high-income countries (Lawn, Cousens, Zupan, & Team, 2005). Babies suffering from hypoxia, when identified, may require additional observation with different methods or a delivery by cesarean section or by instrumental vaginal birth. CTG is usually a continuous measurement method, meaning that the baby is under constant surveillance, distinguishing the method from intermittent alternatives such as auscultation (listening) with a stethoscope. It is however also possible to conduct intermittent CTG monitoring (Alfirevic et al., 2006) and to use the method shortly to screen arriving patients for risk (Blix, 2013). The output of CTG monitoring is illustrated below in Figure 1.

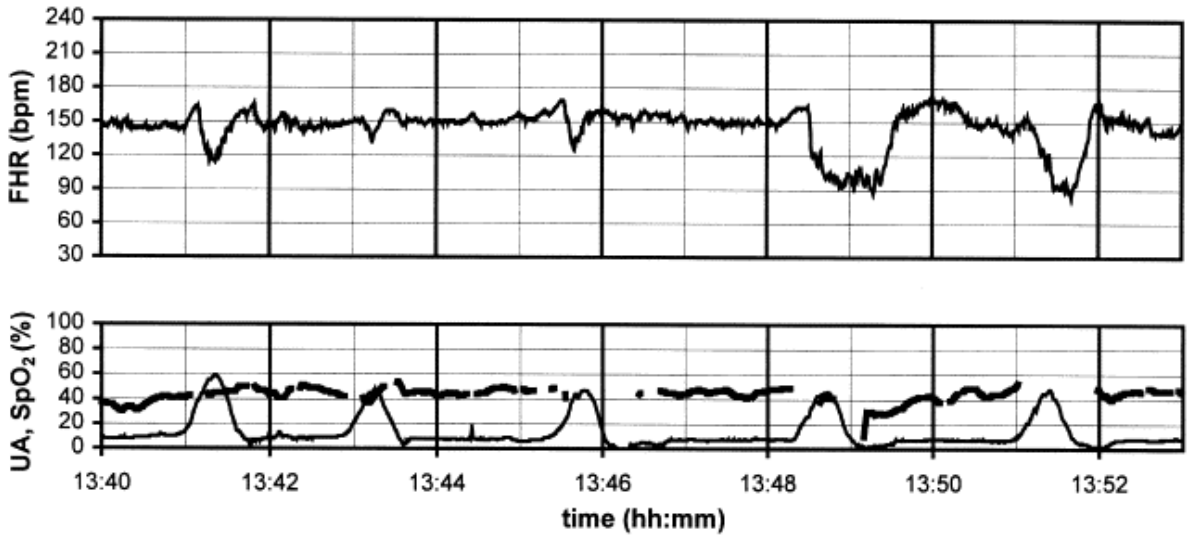

Figure 1. Recording of Fetal Heart Rate (top) and Uterine Activity (bottom lower line) when applying CTG (as presented in Van Den Berg, 1997)

2.2 Clinical Evidence of CTG

Historically, early observational studies on CTG showed a solid correlation between an unusual CTG recording and poor birth outcome (Freeman, Anderson, & Dorchester, 1982; Phelan, 1981). CTG was at the time rapidly and widely adopted without any support from randomized trials, which are considered more robust than observational studies (Pattison & McCowan, 2009). A few years later, a study found that CTG was associated with both false positives as well as false negatives, and warned against the overdependence on CTG that had evolved in the early 1980s (Curzen, Bekir, McLintock, & Patel, 1984). In the 1990s, the view on CTG was that it is a non-specific method that is much too subjective and prone to intra- and inter-observer variability in interpretation meaning risk of wrong decisions being made (Bernardes, Costa-Pereira, Ayres-de-Campos, Van Geijn, & Pereira-Leite, 1997; Donker, van Geijn, & Hasman, 1993).

Recently, a meta-analysis of four other studies found no significant effect of continuous CTG on perinatal mortality and no effect on the frequency of cesarean sections or induction of labor (Pattison & McCowan, 2009). CTG used as a method for screening incoming patients, which was introduced without significant testing in the 1980s, has been shown in another meta-study to have no effect on important measure of fetal outcome. However, these screening tests increased frequency of minor obstetric interventions and possibly the frequency of cesarean sections in the included studies (Blix, 2013). In a study that compared screening CTG with auscultation, screening CTG resulted in no significant reduction of any important measure of birth outcome. However, women that received screening CTG were more likely to be continuously monitored during labor (Mires et al., 2001).

It is clear from the above that clinical evidence of CTG benefits is at best disputed, and at worst non-existent (cf. I Amer-Wåhlin & Maršál, 2011). However, studies have shown that CTG, when used together with other fetal monitoring methods, yields benefits. For example, Berg et. al (1987) found that CTG used together with analysis of FBS in fact detects fetal distress. This study also showed that these two methods used together did not result in a high degree of operative deliveries. One decade

later, a similar study investigated whether CTG used together with Pulse Oximetry (an oxygen saturation measurement with a sensor placed on the infant) improved the ability to assess the baby's condition. This study found that the two methods, used together, leads to benefits in terms of lower operative interventions (van den Berg et al., 1997). It is therefore clear that, while lone benefits are disputed, CTG has benefits when used in combination with other methods.

Today, the main benefit of CTG is believed to be detection of normal progress during labor, while 30-40 percent of babies are somehow deviating and require further analysis using other methods. The reason for this complementary method requirement has been argued to be a lack of informative capacity of measuring only the fetal heart rate. Related to this, it has been further argued that ambiguity and subjectivity in interpretation of CTG contributes to a practice of medicine that increasingly intervenes unnecessarily in normal labor with, for example, fetal blood sampling, caesarean sections and foreceps deliveries. These are associated with risk for both mother and baby. During delivery, there is only one known other signal than the heart rate available from the baby, the ECG (Norén & Rosén, 2008).

2.3 ST Analysis

ST analysis continuously analyzes several parameters that work together in order to detect changes in the ECG waveform of the baby's electric heart impulses, working in parallel to previously described CTG analysis of the regular heart rate. Initial basic research on ECG was done in preclinical studies on animals in the 1970s. It was not until 1993 that the first randomized controlled trial on ST analysis was published (Neoventa.com, 2013).

ECG waves are a summation of electric events inside the cardiac muscle cells. These are passively generated and therefore very stable and suitable for fetal monitoring. The shape of the ST segment of the ECG wave changes if the baby is subjected to hypoxia (Norén & Rosén, 2008). ST analysis is based on computerized analysis of changes in the ECG that results from cardiac muscle cells' adaptation to oxygen deficiency. If the baby is experiencing a normal labor process with sufficient oxygen, the ECG curve will show a normal ST segment (Kazmi, Radfer, & Khan, 2011), as illustrated below in Figure 2.

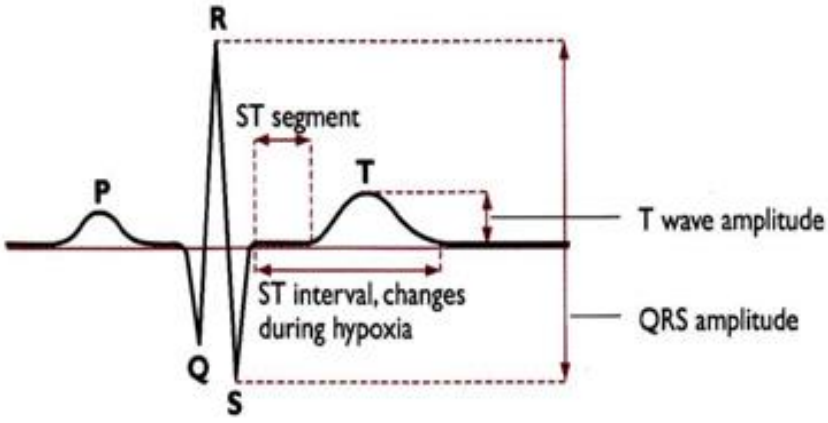

Figure 2. ECG waveform showing normal ST segment (as presented in Kazmi et. al 2011)

However, if the amount of oxygen available is inadequate, the defense mechanisms of the baby will result in a release of stress hormones and a switch to anaerobic (without oxygen) metabolism. This produces a change in the ST segment of the ECG (Kazmi et al., 2011), as illustrated below in Figure 3.

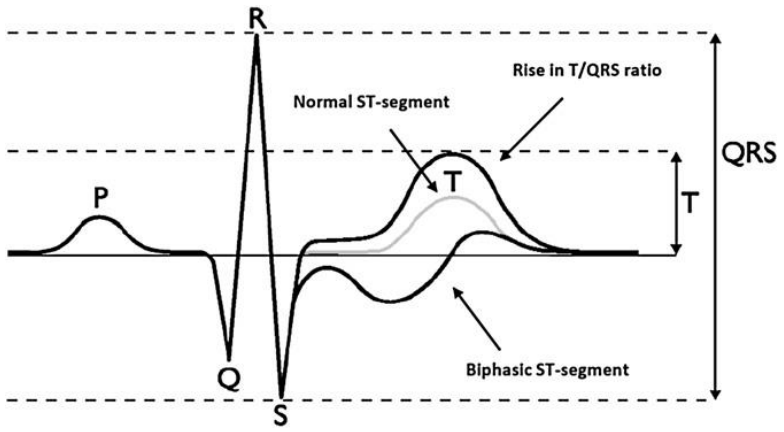

Figure 3. ST analysis - ST rise (fetus responding to asphyxia) and negative ST (fetus unable to respond to asphyxia) (as presented in Amer-Wahlin & Maršál, 2011)

A normal fetal ECG shows a horizontal ST segment, which indicates the baby's ability to deal with labor stress. During oxygen deprivation, breakdown of glycogen from anaerobic metabolism results in an increase of the T-wave height. Hence, T-wave height is a direct measurement indicating fetal oxygen deprivation. A negative T-wave is another form of event that can be measured with ST analysis, and that indicates poor cardiac performance of the baby (Kazmi et al., 2011).

The STAN monitor used for ST analysis shows heart rate and uterine activity, as per CTG. It also shows the fetal ECG and plots "ST events" when the system detects changes in the ECG (such as a rise in the T-wave). The complete picture as typically seen on the STAN-monitor is illustrated below in Figure 4. All information needs to be considered when deciding whether to intervene or not (Kazmi et al., 2011). Further, understanding of ST analysis also requires guidelines. STAN guidelines have been developed and used since the introduction of the method in 2000, revolving chiefly around the fact that CTG and ST analysis must be jointly considered when making decisions (Amer-Wahlin & Dekker, 2008).

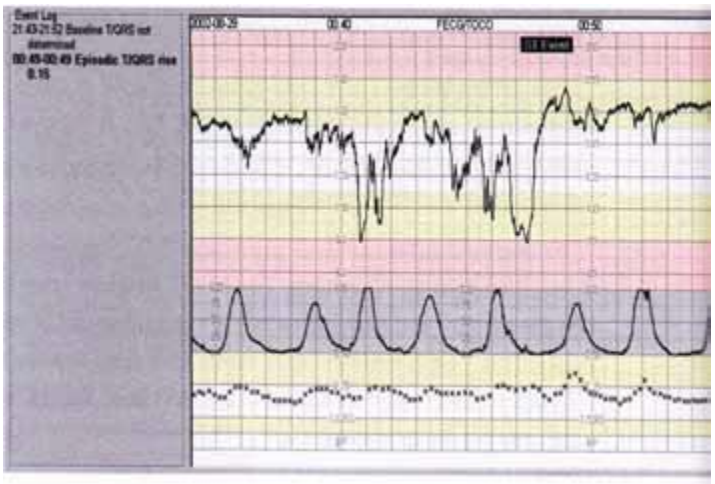

Figure 4. View from STAN monitor showing heart rate (top), uterine activity (middle) and ECG (bottom) (Kazmi et. al 2011)

2.4 Clinical Evidence of ST Analysis

The first experimental studies showing a relationship between the fetal ECG ST segment and the baby's ability to respond to hypoxia were conducted on animals in the 1980s (Dagbjartsson et al., 1989; Hökegård, Eriksson, Kjellmer, Magno, & Rosen, 1981; Rosen, Dagbjartsson, Henriksson, Lagercrantz, & Kjellmer, 1984) and initiated development of the CTG + ST analyzer monitoring system; STAN (Olofsson, 2003).

The first randomized controlled trial (RCT) of CTG + ST analysis, the so-called Plymouth RCT, was conducted in 1993. This study showed a 46 percent reduction in operative deliveries due to fetal distress when using CTG + ST analysis, compared to using only CTG. Also, the study results emphasized the need for technical improvements and education of staff (Westgate, Harris, Curnow, & Greene, 1993). A new system was developed, which was subject to observational studies. These showed that CTG and ST analysis is an accurate method to identify adverse events during labor (Luzietti et al., 1999) and to reduce the threat of asphyxia (Rosen & Luzietti, 2000).

Validation of the new system was done in a Swedish RCT (Olofsson, 2003). The Swedish RCT investigated if CTG + ST analysis could reduce the number of operative deliveries and if it could reduce the number of newborns suffering from metabolic acidosis, a condition caused by hypoxia. These two variables were compared to using only CTG monitoring. Results were significantly lower levels of metabolic acidosis as well as operative deliveries when using CTG + ST analysis (Isis Amer-Wåhlin et al., 2001). The results of this study supported ST analysis as a valuable method. Importantly, the Swedish RCT was the first study that showed both metabolic acidosis reduction and a lowering of operative deliveries. It also supported findings of the previous Plymouth RCT, which increased clinical evidence of the STAN-method as well as its visibility and popularity. It was however clear in the study that clinical professionals are still of critical importance for the outcome, regardless of increased automatic features of STAN compared to CTG (Olofsson, 2003). In June 2007, the Swedish RCT researchers were in a large controversy accused of misconduct leading to an investigation by the Swedish Research Council. The investigators concluded in 2010 that there were a small number of faults in the Swedish RCT study, but not due to misconduct on behalf of the researchers. Faults were specific ambiguous patient cases which were not analyzed in a consistent way. Researchers were prompted to re-analyze the cases in question and submit a correction to the journal Lancet, where the study was originally published (Lu.se, 2007).

Since the Swedish RCT, two smaller ones have been conducted in Finland (Ojala, Vääräsmäki, Mäkikallio, Valkama, & Tekay, 2006) and in France (Vayssière et al., 2007), showing reduction in use of FBS when using CTG + ST analysis but no effect on metabolic acidosis. However a larger meta-analysis, the Cochrane meta-analysis, compiled and investigated the four previous RCTs. It found that the use of CTG + ST analysis was consistent with a trend to less metabolic acidosis, reduction in the use of FBS and reduction in operative deliveries (Neilson, 2006). Most recently, a RCT in the Netherlands showed a reduction in incidence of metabolic acidosis when using CTG + ST analysis, with a significantly lowered use of FBS (Westerhuis et al., 2010). A summary of clinical evidence for ST analysis is provided in Figure 5 below.

Characteristics and main findings of the five published randomized clinical trials comparing cardiotocography (CTG) plus ST-analysis to CTG only as methods of fetal monitoring in labour.

Authors/Year	Number of obstetric units/country	N	Main results
Westgate et al. (1993)[22]	1. UK	2434	Trend to decrease in metabolic acidosis (OR 0.38, 95%CI: 0.13–1.07) Decrease in operative vaginal delivery rate (by 46%; $P < 0.001$ Trend to decrease in low 5-min Apgar score (OR 0.62, 95%CI: 0.35–1.08)
Amer-Wählin et al. (2001)[25]	3. Sweden	4966	Decrease in metabolic acidosis (by 53%; $P = 0.02$) Decrease in operative vaginal delivery rate (by 17%; $P = 0.047$) No difference in rate of fetal blood sampling.
Ojala et al. (2006)[29]	1. Finland	1483	No difference in metabolic acidosis No difference in operative delivery rate Decrease in fetal blood sampling (by 56%; $P < 0.001$).
Vayssière et al. (2007)[30]	2. France	799	No difference in neonatal outcome*; No difference in operative deliveries Decrease in FBS by 56% (RR 0.44, 95%CI 0.36–0.52).
Westerhuis et al. (2010)[32]	9. The Netherlands	5681	Decrease in metabolic acidosis in blood No difference in operative deliveries Decrease in FBS by 48% (RR 0.52, 95%CI 0.46–0.59)

Figure 5. Summary of clinical evidence for ST analysis: the 5 published RCTs (as presented in Amer-Wahlin & Maršál, 2011)

It is clear from clinical evidence that there are benefits of using ST analysis together with CTG monitoring. The three larger RCTs as well as the Cochrane meta-analysis all show a decrease in metabolic acidosis when using CTG + ST analysis. Two of the three larger studies further show a decrease in operative deliveries when using CTG + ST analysis. Both smaller RCTs and the most recent larger one show a decrease in the use of FBS when using CTG + ST analysis.

However, findings also diverge between these studies meaning that the Cochrane meta-analysis becomes interesting. By compiling the first four RCTs, it gives a clear picture of clinical benefits by finding that CTG + ST analysis positively affects all three measurements of a good outcome (decreasing metabolic acidosis, decreased operative deliveries and decreased use of FBS). A large RCT is currently being undertaken in the US, with medical disorder, intervention frequency and intervention type as outcome measures (Clinicaltrials.gov, 2012; Läkartidningen, 2010).

Another aspect of ST analysis is cost effectiveness. Two studies have been made of the cost impact of using CTG + ST analysis in comparison to only using CTG. In the first, it was found that using CTG + ST analysis was much more cost-advantageous in comparison with using only CTG (Heintz, Brodtkorb, Nelson, & Levin, 2008). Vijgen et al. (2011) later found that additional cost of ST analysis monitoring are low in comparison with costs of monitoring with CTG and in comparison to total costs of delivering a baby. Both these studies measured cost reduction in terms of avoided negative clinical outcomes, such as cases of metabolic acidosis.

2.5 Summary

Beginning with CTG, it can be concluded that there is little evidence of stand-alone clinical benefits of the method. Mainly, it has been shown that it is best used to detect when labor is progressing normally in combination with other methods that provide more information in abnormal cases. Regardless of the lack of evidence, the method has been and is widely used around the world. The picture differs when reviewing the STAN-method. Clinical evidence of benefits when used with CTG is here relatively abundant. However, the method is not widely adopted and has even been surrounded by controversy in the form of accusations of misconduct. Controversy is moreover fueled by some smaller and inconclusive studies that are casting doubt on the method's value.

2.6 Relevance for the Thesis

The scientific status of CTG and the STAN-method has an important impact on the methodology chosen to achieve the purpose of this thesis. The wide diffusion of CTG early after its invention and

without significant scientific evidence indicates that a fetal monitoring method's diffusion does not rely entirely upon scientific evidence, even if extensive effort is placed on documenting and testing these methods in the form of trials. The STAN-method's situation supports such a conclusion since it is, in contrast to CTG, very well-documented and associated with positive scientific evidence. The method not being widely accepted and even linked with controversy despite this is a testimony to the fact that other elements than technical, clinical or scientific play a significant part in determining diffusion of a fetal monitoring method. Another way of expressing this is that it is clearly not straightforward to understand a hospital's choice of fetal monitoring method(s).

The impacts of these insights on this study are that a wider set of factors has been taken into account, in order to understand adoption and diffusion of the STAN-method. Following the presentation of respective method's scientific status in this chapter, it is clear that a study only taking this aspect into account would not provide a complete picture. Such a study would disregard much of the real dynamics of diffusion in the fetal monitoring industry. Hence, the wider set of factors that were investigated in this study. The specific set that was used to understand adoption and diffusion will be introduced in chapter 5 "Theoretical framework".

3. Methodology

This chapter presents the methodology of the thesis. Specifically, it describes the choices of research strategy and process, the associated problem-solving approach, the choice of research design, the use of research methods and the choice of sampling approach. The chapter is concluded with a discussion of validity and reliability.

Due to an initially loosely defined problem and relatively low knowledge on the topic from the researchers, a stepwise approach was required in this study. This approach involved choosing research strategy and designing a stepwise research process early on in order to clarify and structure the problem at hand. Therefore, this chapter will, in section 3.1 "Research Strategy and Process", describe choices of research strategy and process along with their methodological consequences. After having addressed these higher level aspects, specific methodological issues such as design, data collection, data analysis, sampling and quality of research will be respectively discussed in section 3.2 "Research Design", 3.3 "Sampling" and 3.4 "Quality of Conducted Research".

3.1 Research Strategy and Process

The cause and exact nature of the problem, experienced barriers to adoption and diffusion of the STAN-method, was initially described by Neoventa as uncertain and in loose terms. The general aim was however clear, to investigate the adoption decision and the process of diffusion of the STAN-method. Diffusion is a process in which social actors have big influence, which had an impact on the choice of research strategy. The uncertainty in problem nature and cause further led to a choice of a phased research process. Research strategy and process will next be presented in separate sections.

3.1.1 Research Strategy

A quantitative business research strategy emphasizes quantification in collection and analysis of data while a qualitative strategy does not. Moreover, qualitative research approaches theory creation from an empirical starting point. Of special importance to business research, a qualitative approach means viewing social reality as being constantly created and changing as a result of the actions of and interactions between individuals (Bryman & Bell, 2007, pp. 26-28), and emphasizes understanding through an examination of them (Bryman & Bell, 2007, p. 386). The nature of this study is qualitative, placing emphasis on understanding rather than quantification. The main reason for this is because the sought outcome of the study is not quantitative in nature or even quantifiable. Rather, an understanding of the nature of a social problem is sought, meaning that it is mainly determined by the decisions of individuals and social groups, along with an insight into what the relevant factors are to overcome the problem.

3.1.2 Research Process

The choice of research strategy determines research execution. As mentioned above, qualitative research does not take a starting point in theory. Rather, it begins with a planning phase where objectives are defined and data collection is organized. This is followed by actual data collection and interpretation. Only once these steps are completed is theory brought into the process. Findings or conclusions result from researchers' work with connecting empirical findings and theory. Often, a loop of tighter research question specification followed with more data collection may be required (Bryman & Bell, 2007, pp. 389-390). These steps are illustrated in Figure 6 below.

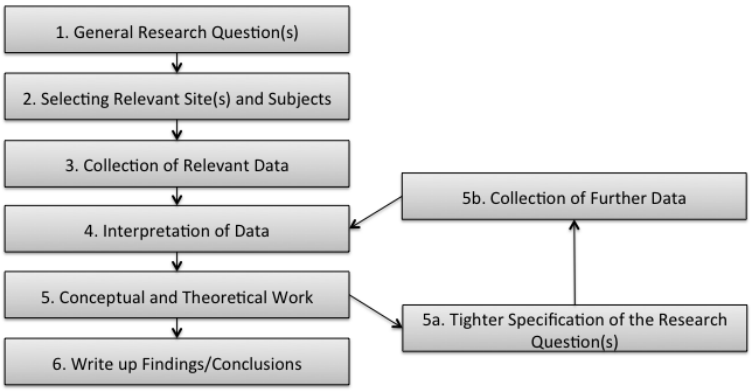

Figure 6. The main steps of qualitative research (as presented in Bryman and Bell, 2011 p.390)

Due to the loosely formulated initial problem, the decision was made to employ a phased research process. The aim was to increase clarity and reduce uncertainty with each phase, where the first aimed to clarify the problem's general nature. This phased decision was also taken to enable a stepwise formulation of more accurate research questions. The research process in this thesis thus begun with an exploratory phase. Thereafter, a pilot research question could be formulated. A pilot study was then designed in order to further clarify the problem nature and answer this question. However, the pilot study also aimed to explore the cause of the problem. Once it was completed, the researchers compiled findings and generated insights into both nature and cause of the problem. At this time, knowledge about the nature and cause of the problem had increased to a level where appropriate further research questions could be formulated, and further phases of research could be designed to answer them. Specifically, a main research question and two sub questions were formulated at this stage of the process.

In order to address the main research question and the two sub questions, a continuation study was designed. The continuation study aimed to identify how the problem had been overcome in individual success cases. In order to be able to extract learnings from the continuation study, the researchers designed and executed a theoretical study in parallel. Insights from theory could then, together with empirical findings, be applied in the analysis phase to generate insights that constitute an answer to the main research question of this thesis; what Neoventa can learn from investigated success cases. The research process is illustrated in Figure 7 below.

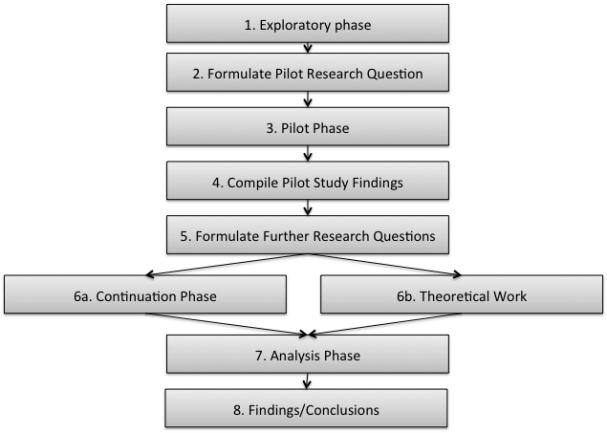

Figure 7. The research process of this thesis

Each of the phases involving data collection (exploratory-, pilot- and continuation-) required different research designs, different sampling and led to consequences for validity and reliability. Choices made in relation to these specific methodological considerations will be presented further on in section 3.2 “Research Design”, followed by the consequences in section 3.3 “Quality of Conducted Research”.

The research process was further inspired by the “W-Shaped Problem-Solving Method” by (Kawakita, 1991), which is a model of the basic steps of problem solving. This model stipulates that there are two levels on which a problem is solved, the level of thought and the level of experience. The level of thought describes mental activities while the level of experience describes concrete actions, each important in different stages of the research process. Problem solving is advanced by moving back and forth between the two levels, resulting in a W-shaped model. In each step, different activities and research designs may be required (Kawakita, 1991). Figure 8 below illustrates the model.

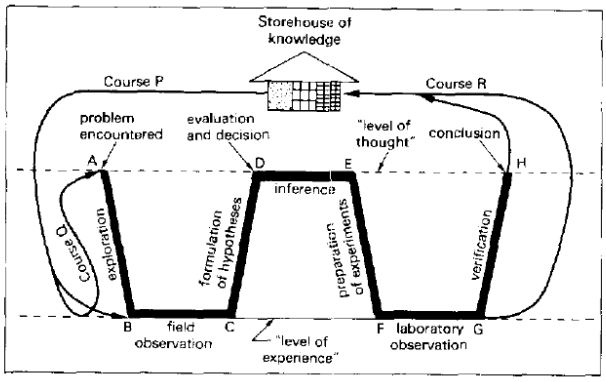

Figure 8. Basic steps of problem solving, the W-model (as presented in Kawakita, 1991)

In the research process of the present study, the exploratory phase corresponds to the path A-B in the W-model, while the pilot phase corresponds to the path B-C. Clearly, exploration occurred at the level of thought while the pilot phase occurred at the level of experience, since it is concrete. After the pilot phase, the researchers compiled insights and generated further research questions, corresponding to path C-D-E in the W-model. Most importantly, this was a return to the level of thought. Following this, the continuation study meant a revisit at the level of experience in terms of the W-model and path E-F-G. The final analysis phase, G-H in the W-model, occurred at the level of thought. With some exceptions, such as parallel theoretical work, the process of research in this thesis involved weaving back and forth between thinking and concrete actions. This stepwise approach was helpful in order to solve the initially loosely defined problem.

3.2 Research Design

A research design can be described as a framework for both data collection and data analysis. Which design to choose is a reflection of priority placed on different aspects of research. Aspects include causality between variables, generalization beyond instances included in the study and understanding social behavior in its context (Bryman & Bell, 2007, pp. 40-67).

The exploratory phase employed a research design, which can be described as simple. Due to the deliberately quick nature of the phase, observations were made quickly and immediately analyzed to

increase problem knowledge. Since the amount of data was relatively small, a framework from structuring data was not deemed necessary. This lack of structure can be a potential weakness, which needs to be discussed. In fact, such an approach relies heavily upon where observations are made, with whom and how the researchers interpret them. On the other hand, in the context of this phase of the study, such an approach had large advantages when seeking a speedy problem understanding.

For the pilot study, a comparative design was chosen. A comparative design involves using similar or even identical methods on two or more cases that contrast each other. The important factor in this design is the logic of comparison. In fact, it has been found that social phenomena can be better understood by comparison if the cases contrast each other in meaningful ways (Bryman & Bell, 2007, p. 63). Comparative designs often take the form of a study of multiple cases, such as organizations (Bryman & Bell, 2007, pp. 66-67). Cases that were compared in the pilot study were health organizations with obstetric operations. Since the pilot research question dealt with the nature of adoption and diffusion barriers, the chosen meaningful difference was whether and to what extent the organization had adopted the STAN-method. Specifically, a four-case comparative study was designed with cases differing along this dimension, as illustrated in Figure 9 below.

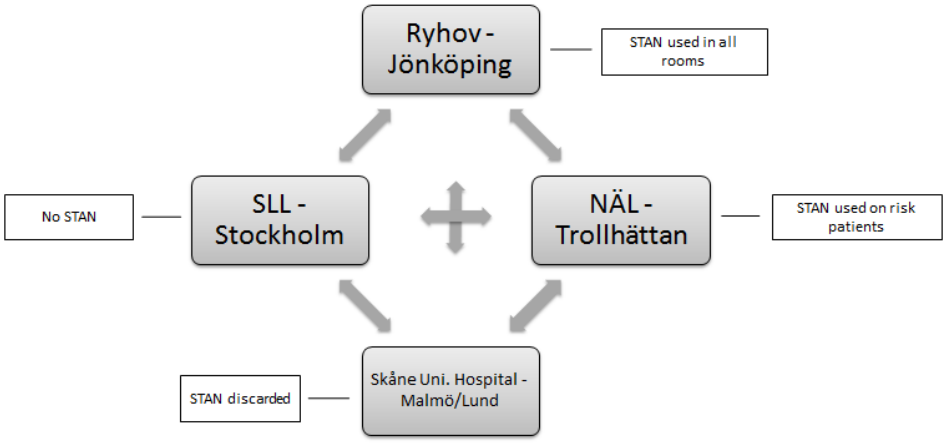

Figure 9. Comparative design of the pilot study along the dimension "degree of STAN adoption"

This design resulted in advantages in understanding the dynamics of the chosen dimension. However, a weakness when using such a design is that other aspects that may be important risk to be overlooked. In the case of this thesis, the chosen dimension of comparison was closely tied to the overall purpose, reducing this risk. Another weakness was a limited availability of cases that fulfilled the criteria of being different in the chosen dimension. As a consequence, the applicability of findings in other contexts had to be carefully considered. In fact, the possibility of connecting the comparative dimension and the overall purpose of the study was the main reason for the choice of a comparative design. Weaknesses with external validity, the applicability of findings to other contexts, are addressable since the pilot study is only one phase of a larger research process. It was however deemed important to continuously assess findings from each stage to avoid designing further research upon less valid findings from previous phases.

For the continuation study, a multiple case study design was chosen, see Figure 10. Such a design focuses on the specific nature and particular complexity of the cases themselves, but is also an extension of the single case study design, employing several case studies with a particular purpose (Bryman & Bell, 2007, pp. 59-63). For the continuation study, the cases chosen were success cases, or health organizations, which had adopted the STAN-method enthusiastically. The purpose was to find common attributes, which could later be extracted as learnings in the analysis phase. In this sense, also the continuation study can be viewed as a comparative design. However, the purpose was not understanding through meaningful differences as in the pilot study. Rather, it was to understand through commonalities. This is illustrated in Figure 10 below. In order to better understand the context of each success case, relevant sales employees at Neoventa were also interviewed as a part of the continuation study. By doing this, the Neoventa-internal view could be used to both prepare the external case interviews and to understand the individual success cases and their context better. The main advantage of using this design is that commonalities between different contexts can be found. In fact, a challenge in achieving the purpose of this thesis and a limitation from the pilot phase is to address these differences in context between hospitals. By comparing success cases that are by definition contextually different, their common aspects are less dependent on context and thus more generally applicable than if analyzed individually. Previous investigation of unsuccessful cases in the pilot study provided further insights on differences in contexts and functioned as a contrast in this phase. A disadvantage of the comparative design as used here is that it is dependent upon which cases are chosen to be compared. This issue was addressed by including the Neoventa internal interviews with employees closely connected to each case, thereby ensuring that the researchers knew the actual consequence of choosing these particular cases for comparison. Bias on behalf of the researchers was not an issue in choosing cases, since relatively few success cases were in existence.

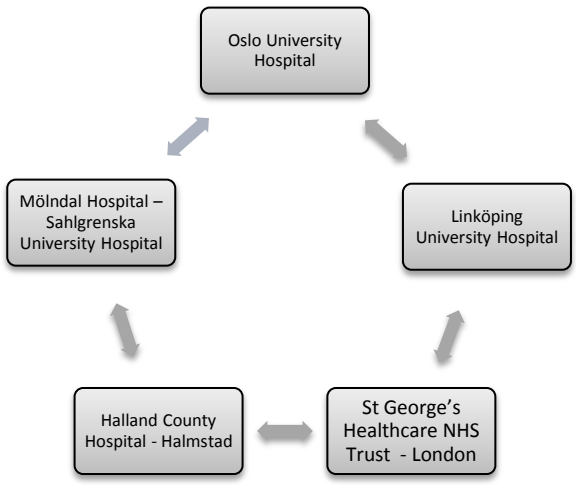

Figure 10. Comparative Design of the Continuation Study

3.2.1 Data Collection

Data collection during this study reflected the qualitative research strategy employed, mainly using unstructured and semi-structured interviews. The main reason for this choice was a need for flexibility and following the direction that interviewees take. In fact, the initially loosely defined problem required continuous adjustment as interesting issues emerged during interviews. The fact that respondents were clinical professionals also meant that their available time was limited. This

meant impracticality in employing other more time-consuming qualitative methods. These issues considered; the unstructured and semi-structured interviews were deemed to be the most appropriate research methods to use. Focus was, as prescribed when employing qualitative interviewing, placed on the interviewees' own understanding of events to investigate the central issues of adoption and diffusion (Bryman & Bell, 2007, pp. 466-467).

For the exploratory study, unstructured interviews were used. Respondents were asked to elaborate freely on the topic of experienced barriers to adoption and diffusion. As prescribed by Bryman and Bell (2007, p. 467), the interviewers here simply took note of points that appeared interesting to follow up on. The outcome of these exploratory interviews was a compilation of parameters that respondents believed to be causing adoption and diffusion barriers. This lack of structure was very advantageous at this stage since the problem was loosely defined and maximum flexibility was needed to follow up on issues as they arose. Moreover, low problem and field knowledge on behalf of the researchers meant that it was difficult to employ any method with more structure at this stage, as appropriate questions and language were unknown. The flexible and open nature made this type of interview especially suited to fulfill the purpose of this phase. The unstructured interview was repeated four times with four key employees at Neoventa, reducing the previously mentioned risk of missing important aspects when proceeding through the phased research process. At the same time, flexibility was maintained enabling the researchers to follow up on new aspects as they emerged.

For the pilot study and the continuation study, semi-structured interviews were used. In such interviews the researcher uses a list of questions on some relatively specific topics, referred to as an interview guide. However, the interviewer has freedom to deviate from the guide upon encountering interesting issues (Bryman & Bell, 2007, p. 467). The pilot and continuation studies required some structure since specific aspects uncovered in previous phases were to be investigated. Also, the structure enabled some degree of comparison, which was required to fulfill the comparative design chosen for both these phases. Specifically in the continuation study, the objective was for interviewees to reconstruct past events, something that cannot easily be achieved with any other method than interviewing (Bryman & Bell, 2007, p. 496). Moreover, the sought aspects or data were at this point loosely defined and context-dependent. It was deemed likely that each success case differed along several dimensions, notwithstanding existence of commonalities. Applying excessive structure to the interview would entail losing the ability to understand nuances between contexts and the ability to pursue the salient aspects of each case in depth. Therefore, it was concluded that semi-structured interviewing was a valuable data collection method in relation to the purpose of this phase.

Researchers in this study followed the guidelines of Bryman and Bell (2007, p. 475) when preparing the interview guide for semi-structured interviewing in the pilot- and continuation study. This initially entailed creating an ordered list of topics to address during the interviews. Once the topics had been decided, one or several questions were developed in order to address each topic. The final topics included but were not limited to the parameters that were the outcome of the exploratory study. Each topic and corresponding questions was also complemented with probing questions. Probing questions are used to follow up earlier statements (Bryman & Bell, 2007, p. 477). This structure of topics, questions and probes was used to avoid vague, equivocal or irrelevant answers.

A representative example of the interview guides used is provided in the appendix of this thesis.

3.2.2 Data Analysis

Data analysis was conducted at two stages in the research process of this thesis, at the end of the pilot study and after the continuation study and parallel theoretical work. Firstly, analysis of data in the pilot study was done through compiling observations. Mainly, ways in which observations were similar or different across instances was established. Also, elimination, confirmation or addition of parameters relevant to the adoption and diffusion barriers was done. In fact, the parameters were the outcome of the conducted analysis, their aim being to describe barriers of adoption and diffusion of the STAN-method and, hence, to answer the pilot research question.

Secondly, upon completion of the continuation study and parallel theoretical work a more extensive data analysis was undertaken. This analysis involved synthesizing empirical findings from the continuation study with the theoretical work. The outcome of the theoretical work; a medical technology diffusion framework and a technology marketing model, enabled an understanding of the observed phenomena. More specifically, similarities across instances in the continuation study were compiled. However, an important part of the analysis at this stage was also to observe differences between cases investigated in the pilot study and cases investigated in the continuation study. Such a comparison is necessary in order to understand how success cases differ from cases where barriers have led to problems. In turn, this understanding led to an ability to identify which parts of the medical technology diffusion framework were the most salient in the specific case of the STAN-method. This directly contributed to answering the main research question of this thesis; to identify relevant factors for Neoventa to address in seeking to overcome barriers to adoption and diffusion of the STAN-method. It is of importance that the two different parts of the outcome from the theoretical work, the framework and the model, were each applied to different parts of the empirical findings. Application of the theoretical framework will be presented and discussed in section 5.3 “Application of the theoretical framework”.

In all instances, visual inspection of interview transcripts and notes along with a control of inter-observer consistency were the data analysis method used. The advantage of visual inspection is mostly that it may be the only applicable method available to analyze qualitative data. Disadvantages mainly include bias on behalf of the researcher. The choice of visual inspection in this case arose from a lack of options and from the fact that it was useful, when applied systematically, to unravel qualitative similarities and differences between cases.

3.3 Sampling

Sampling for all phases of data collection in the present study was non-randomized. In the exploratory phase, purposive sampling was used because of the need to reach contextual knowledge. This meant that interviewees were chosen with certain research goals in mind (Bryman & Bell, 2007, p. 442), specifically to understand the STAN-method, its market and its customers. The resulting sample was four Neoventa employees; the CEO, Sales Director, Medical Director, Head of Clinical Support and Regional Sales Manager. This type of sample with a purpose in mind and with respondents that have key expertise has also been referred to as a key informant sample (Marshall, 1996).

In the pilot study, the specific sample was of more importance. Since the overall structure entailed conducting a specific amount of interviews at specific hospitals exhibiting a certain degree of adoption, quota sampling was used. The pilot study quotas were one hospital each having the

following characteristics: extensive user of the STAN-method, sparse user of the STAN-method, previous user of the STAN-method which has abandoned use and, finally, a hospital that has never used the STAN-method. The researchers attempted to secure interviews until these quotas were filled. Quotas were also used for determining interviewees at each hospital: one senior doctor and one senior midwife were required. Further, one of these should be in a key decision-making position in relation to adopting fetal monitoring methods. If possible in the applicable time frame, it was also decided to fill the quotas of one medical technology engineer at each hospital and one senior administrative decision-maker.

The sampling approach used in the continuation study was inspired by theoretical sampling, an approach where the researcher collects, codes and analyzes data all at once. The process continues until theoretical saturation, in other words when no new relevant data is gained by further collection (Bryman & Bell, 2007, p. 443). The continuation study did not attempt to develop any new theory, but rather to find commonalities between Neoventa's success cases. The connection to a theoretical sampling approach is that researchers continued to investigate success cases until a time where commonalities could be discerned clearly and no new interesting data emerged. Naturally, there was also a limit as to the number of success cases available, particularly in Sweden. The result was five success cases; Oslo University Hospital in Norway, The university hospital in Linköping, Mölndal Hospital, Sahlgrenska University Hospital, St George's Healthcare NHS Trust in London, UK, and Halland County Hospital in Halmstad. To ensure that findings abroad are applicable in the comparison the present study aims to conduct, two interviews were conducted on the specific topic of differences in context between countries.

A list of interviews from all data collection phases along with interviewees' respective positions is provided in the appendix of this thesis.

3.4 Quality of Conducted Research

A central concept in evaluating the value of qualitative research is trustworthiness, which in turn consists of credibility, transferability, dependability and confirmability (Bryman & Bell, 2007, p. 395).

Credibility is centered on the fact that there can be many different views of a social phenomenon and that a researcher must ensure that he or she has understood social reality correctly (Bryman & Bell, 2007, p. 396). Efforts were continuously made to ensure credibility in two ways. Firstly, respondents were at the end of each interview asked to validate a summary of notes taken. In several cases, this led to slight adjustments in responses. Secondly, both the pilot- and the continuation study employed data source triangulation in the form of multiple conducted interviews to cover each hospital or case. Together, this ensured adequate understanding of social reality as well as multiple views being taken into account.

Transferability describes whether qualitative findings in a particular social context are applicable to other contexts or cases that were not included in the study (Bryman & Bell, 2007, p. 398). To ensure the possibility for others to judge transferability of findings presented in this thesis, focus was placed on extensive descriptions of the context under study. This is manifested by relatively large and detailed empirical chapters that address the background and context of each case. Such rich accounts of context are sometimes referred to as thick descriptions (Bryman & Bell, 2007, p. 398).

Dependability refers to the reliability of a qualitative study, meaning whether the study could be duplicated by others with similar results and whether members of the research team agree on what has been observed (Bryman & Bell, 2007, pp. 395-398). Researchers chose to transcribe all interviews during this study to improve duplicability. Further, dependability was improved through both members of the research team being present during all interviews and an ensuing independent validation of the interview transcripts. This ensured agreement on observations.

Finally, confirmability deals with the objectivity of the researchers in relation to the studied phenomenon (Bryman & Bell, 2007, p. 398). In this study, no apparent risks for subjectivity on behalf of the researchers were encountered. However, reflexivity was applied, meaning that researchers were continuously mindful of the fact that complete objectivity is difficult in qualitative research. Steps were then taken to minimize the effect of bias. These included team members reviewing each other's transcripts. There was, however, a potential risk of subjectivity on behalf of respondents, since the value of the STAN-method has been disagreed upon in the Swedish medical devices community for a longer period of time. Researchers attempted in interviews to quickly identify and respondents' opinions with purposeful background questions. To counter subjectivity, transcripts were then analyzed as objectively as possible with respondents' opinions in mind.

3.5 Concluding Summary of Methodology

An originally loosely defined problem but with clear connection to the social process of innovation diffusion in the medical devices industry led to the choice of a qualitative research strategy and a phased research process. Initially, an exploratory study with key informants employed a simple research design and unstructured interviews to quickly increase problem and field knowledge. Following this, a pilot study employed a comparative design with four hospitals that differed along one central dimension; their degree of STAN adoption. This design was chosen due to the possibility of comparing along a dimension that is closely connected to the purpose of this thesis; to investigate adoption and diffusion barriers of the STAN-method. By finding meaningful differences in connection to this dimension, causes and nature of the problem addressed in the purpose could be understood. A comparison requires some structure, which led to the choice of semi-structured interviews in this phase. Finally, a theoretical phase and a parallel continuation study were designed, where the continuation study employed a reverse logic in relation to the pilot study and aimed to find similarities between cases where the problem has been overcome. Such a comparison enables an understanding of success in different contexts, namely the different cases under investigation, and is useful to achieve a more generalizable understanding. Semi-structured interviewing was used also here, due to a requirement of both structure and flexibility. The theoretical phase was, finally, synthesized with the continuation study in order to analyze what Neoventa can learn from success cases. The final analysis that followed the theoretical work and the continuation phase also included comparing pilot study unsuccessful cases with continuation study success cases.

4. Previous Research

This chapter presents the historical milestones in the diffusion research field and further examines important developments in the sub-field medical technology diffusion. The chapter is concluded with the relevance of previous research for the purpose of present study.

The first study in the field of diffusion research was presented by the French author de Tarde in 1890 in his book *The laws of Imitation*. According to de Tarde (1890), inventions diffuse by a process of imitation where less venturesome people imitated beliefs or motives from innovators. Thus, de Tarde (1890) identified the role of opinion leaders and social status in the diffusion process. The process of diffusion could be understood in terms of rings on water; where innovations were described as spreading like rings on water from a geographical point where the innovation was first adopted. De Tarde (1890) also initiated the idea behind the diffusion S-curve, which was further developed by Ryan and Gross (1943) and became a key concept within diffusion research. The diffusion S-curve is illustrated in Figure 11 below.

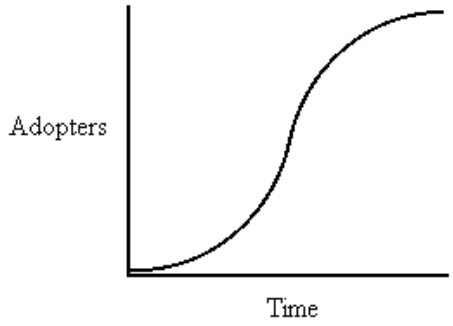

Figure 11. Diffusion S-Curve (as presented in Rogers 2003, p. 11)

Ryan and Gross (1943) and their study of diffusion of hybrid corn among farmers in Iowa became the next milestone in the diffusion research field. Ryan and Gross (1943) concluded that the diffusion of corn followed an S-shaped pattern. The S-curve showed the cumulative number of adopters over time. Initially, the number of adopters grew slowly, followed by a period of rapid adoption. Gradually, the rate of adoption leveled off as fewer and fewer potential adopters were left in the population. According to Ryan and Gross (1943) the diffusion process could be understood in terms of social processes, where adoption was based on subjective evaluation rather than rational decisions, which meant that individuals primarily adopted because others in their social network adopted. This study of diffusion of hybrid corn resulted in an upturn for diffusion research and the number of publications within the area increased significantly in the subsequent time period (Rogers 2003).

Ryan and Gross's (1943) study influenced many succeeding diffusion studies, not least Rogers' diffusion model (1962), which became the next theory of key importance in the field. The initial model published in 1962 was revised and further developed for several years and met its final form in 1995. Today, it is the most accepted model of diffusion and adoption of technological innovations. The model views the adopter as passive, merely accepting the innovation. Further, it assumes that innovations spread to the entire population, which has been referred to as a pro-innovation bias

(Szczepura & Kankaanpää, 1996). Due to its major importance for the diffusion research field, major concepts of the model will be presented more in detail here.

According to Rogers (2003), the diffusion process contains four main elements; innovation, communication channels, time and social system. Those four elements can be used to explain and define diffusion as "the process in which an innovation is communicated thorough certain channels over time among the members of a social system" (Rogers 2003, p. 5). Further, the decision to adopt an innovation among members of a social system can be explained as a process of five steps that usually follow after each other (1) knowledge, (2) persuasion, (3) decision, (4) implementation, and (5) confirmation. (Rogers 2003, p.172)

An important part of the diffusion process is to reduce uncertainty among members of a social system to facilitate the adoption decision (Rogers 2003, p.232). According to Rogers (2003), there are five attributes of innovations that impact the feeling of uncertainty: (1) relative advantage, "the degree to which an innovation is perceived as being better than the idea it supersedes" (p.229), (2) compatibility, "the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters" (p.15), (3) complexity, "the degree to which an innovation is perceived as relatively difficult to understand and use" (p. 15), (4) trialability, "the degree to which an innovation may be experimented with on a limited basis" (p. 16), and (5) observability, "the degree to which the results of an innovation are visible to others" (p. 16). The individual perception of those attributes will impact the adoption decision and thus the rate of adoption among a population, which is "the relative speed with which an innovation is adopted by members of a social system" (Rogers 2003, p. 221). The speed with which a member of a social system adopts an innovation can also be understood by considering the innovativeness of individuals, which is the "the degree to which an individual or other unit of adoption is relatively earlier in adopting new ideas than other members of a system" (Rogers, 2003, p. 22). Members of a social system can be classified, on the basis of innovativeness, into five major groups: innovators, early adopters, early majority, late majority, and laggards (Rogers, 2003). These groups make up the Innovation Adoption Lifecycle, which is illustrated in Figure 11 below.

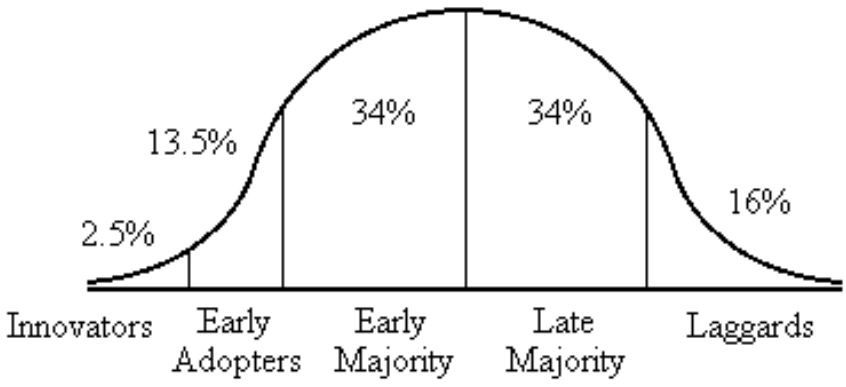

Figure 12. Innovation Adoption Lifecycle (as presented in Rogers 2003, p.281)

As mentioned above, Rogers' work on diffusion has provided an important basis for subsequent diffusion research. Not least, the model has been widely used a starting point when studying diffusion of medical technologies (Battista, 1989; Ghodeswar & Vaidyanathan, 2006; Greenhalgh et al., 2004; Greer & Greer, 1984; Robert, Greenhalgh, MacFarlane, & Peacock, 2009; Van de Ven,

1991). For example, early research found that diffusion in health innovations followed the same pattern as that in other industries, namely the S-curve (Russell, 1977). However, important to note is that Rogers' diffusion model concerns the process of adopting innovation by individuals, which in many aspects is different from the process of adopting innovations by organizations. Diffusion literature has over the years increasingly recognized that the process of diffusion and adoption on the organizational level is much more complex in comparison to the individual level. Therefore, many authors studying diffusion of medical technologies, where organizations are large and important, have adapted Rogers' diffusion theory to fit the organizational context (Battista, 1989; Ghodeswar & Vaidyanathan, 2006; Greenhalgh et al., 2004; Greer & Greer, 1984; Robert et al., 2009; Van de Ven, 1991).

The first diffusion work in the area of medical technologies was published by Coleman, Katz and Menzel (1957) who studied the spreading of a new drug among a population of physicians. The focus of the study was social processes and how social networks and important opinion leaders influenced the adoption of the drug among physicians. While this study discussed diffusion among physicians, i.e. diffusion on an individual level, subsequent studies gradually acknowledged that diffusion of medical technology was a complex process involving several actors (Battista, 1989; Greer & Greer, 1984). Greer and Greer (1984) concluded that hospitals could not be seen as a single decision unit where adoption decisions were dominated by one single group of actors, the doctors. Instead adoption of new technology involved at least three groups of actors, physicians, administrative personnel and hospital board members. Also Battista (1989) underlined the complexity of technology diffusion in hospitals and expanded the actors involved in the diffusion process to producers, government, user organizations (hospitals), user professionals (doctors, nurses) and patients. Thus, both Greer and Greer (1984) and Battista (1989) discussed the importance of understanding the complexity of diffusion on organizational level.

Research linking adoption, diffusion and medical technology also identified early that other factors than technological characteristics were of importance. In a study of computer technology adoption for clinical use, Globerman (1982) found that factors such as the size of the organization, whether it is for-profit or non-profit (i.e. a public or private hospital) and external factors, such as government policy, affected the adoption of an innovation. Research in the field has continued to investigate and conclude that adoption and diffusion of medical technology rests upon not a few but many factors. Dirksen, Ament et al. (1996) introduced the measure of whether a hospital is teaching as an important variable. Further, the authors found that financial aspects associated with adoption could restrain diffusion while high patient demand, media and competition among individuals could stimulate it. The nature of the technology itself could, in their study, either stimulate or restrain diffusion, which testifies to the fact that technological aspects remain important regardless of the complex organizational setting.

A few years later, Wilson, Ramamurthy et al. (1999) developed a multi-attribute measure for adoption of innovation, applying it to the context of medical imaging technology. Interestingly is that, while basing the model on only two attributes, radicalness and relative advantage, the application of the model to the health context generated significantly more complexity. In the context of medical imaging, radicalness had to address skill requirement to adequately use the technology, degree of departure from current clinical practice and degree to which new clinical ground was broken with the technology. In turn, relative advantage had to consider service to patients, productivity of workers,

clinical benefits, cost/labor ratio, reliability and consistency as well as hospital-level strategic benefits. Synthesizing studies in diffusion of medical technology during the late 1980s, Szczepura and Kankaanpää (1996) conclude that the "new" view is that medical technology diffusion has three determinants. These are actors in the process, the structure or the environment and the characteristics of the innovation. They also find that actors are dominating in terms of influence.

This review of previous literature confirms diffusion of innovations is a well-researched area. The existing literature on diffusion, and particularly diffusion in relation to medical technologies, can be considered highly relevant for analyzing the adoption and diffusion of the STAN-method. This is mainly due to two reasons: First, although early literature on diffusion as well as Roger's later work primarily focuses on diffusion on the individual level, later research, and especially research within the area of medical technologies, have been focusing on the organizational level. The organizational perspective is crucial for this thesis since the aim is to understand the adoption and diffusion within complex organizations. Second, the majority of research within the field of medical technology is not primarily focusing on pure scientific or functional aspects of the innovative technology but rather on other surrounding factors such as social processes and individual characteristics of the adopter. As the present study intends to understand the adoption barriers to the STAN-method beyond the discussion of the method's scientific results, the existing research is very helpful in addressing the purpose of this thesis.

To summarize, it is clear from the application of diffusion research to the field of medical technology that many different factors need to be addressed in order to adequately understand the process by which this category of innovations are adopted and, hence, diffuse. Factors of importance are on the individual, organizational, and technological as well as the external level and one must take into account the many different categories of professionals involved and their performance objectives. In other words, the adoption and diffusion of a medical technology is not a simple process and to develop an overview of what is impacting the adoption and diffusion process, the different factors can be complied into a framework.

5. Theoretical Framework

This chapter presents selected theory that forms the basis for the analysis of the continuation study. The theoretical framework consists of two parts: a diffusion framework and a technology-marketing model. The diffusion framework intends to analyze the dynamics of medical technology diffusion within hospitals. Further, in order to also understand actions that can be taken by a firm to stimulate diffusion, the influential work in marketing of technology by Moore (1991) is introduced as the technology-marketing model.

5.1 Diffusion of Medical Technology Framework

As concluded from the review of previous research, several different aspects need to be taken into consideration when studying adoption and diffusion of medical technologies. Greenhalgh et al. (2004) and Ghodeswar and Vaidyanathan (2007) have recently studied existing literature in this field and developed frameworks that can be used to understand the adoption and diffusion of medical technologies within organizations. The purpose of those two frameworks is consistent with the purpose of this thesis, making them very useful. Both frameworks consist of a number of areas that influence and determine the adoption and diffusion of innovations within organizations, such as for example technological factors and individual characteristics (Ghodeswar & Vaidyanathan, 2007; Greenhalgh et al., 2004), meaning that they fulfill the established need to consider a broad set of factors. The diffusion framework developed in this section aims to analyze adoption and diffusion of medical technologies within hospitals, and is based on a combination of the areas presented in the frameworks by Greenhalgh et al. (2004) and Ghodeswar and Vaidyanathan (2007). It is however also complemented with additional relevant research.

This work resulted in a diffusion framework that is built around the following areas: (a) Technological Factors, (b) Organizational Factors, (c) Individual Characteristics, (d) Internal Influencers, (e) External Environment (f) Organizational processes and Implementation. Factors in each area measure different concepts that are important to diffusion. For example, those in individual characteristics measure individuals' exposure and motivation to adopt an innovation, while factors in organizational processes and implementation measure aspects that determine likelihood of adoption success at an organizational level. Hence, the framework effectively enables a broad analysis of different aspects that together enhance or suppress diffusion of a medical technology innovation. As previously described the problem area and purpose of this thesis calls for such a broad approach, meaning that these relative differences between framework areas are purposeful.

5.1.1 Technological Factors

As discussed above, Rogers (2003) has identified five attributes of technologies that impact the diffusion of technological innovations among members of a social system: relative advantaged, compatibility, complexity, trialability and observability. According to research in the medical device field, those factors are also relevant when analyzing diffusion of medical technologies within organizations (Ghodeswar & Vaidyanathan, 2006; Greenhalgh et al., 2004). For example, in terms of relative advantage, Teplensky et al (1995) identifies three major rationales for hospitals to adopt new technology: maximize profit, create an image of technological

Table 1. Technological Factors

Technological Factors
Relative advantage
Compatibility
Complexity
Trialability
Observability
Risk
Reinvention
Task Issues
Knowledge required for use
Augmentation/support

leadership to attract doctors and patients and meet the actual clinical needs of patients.

However, those five attributes are not enough to understand organizational adoption behavior. Research on diffusion of medical technologies has identified a number of additional factors needed to understand the complete picture of how technologies diffuse within hospitals (Ghodeswar & Vaidyanathan, 2006, 2007; Greenhalgh et al., 2004). For example, Greenhalgh et al. (2004) and Ghodeswar and Vaidyanathan (2006) identify risk and reinvention as two important factors. New technology can be associated by certain personal risk; in addition the risks and benefits of adopting a technology are usually not even distributed in an organization. Depending on the perceived risk by the power base of the organization, the technology will be more or less likely adopted (Greenhalgh et al., 2004). Reinvention refers to what degree the technology can be adapted and modified to fit the needs and structure of the organization (Greenhalgh et al., 2004).

Other technological factors discussed in literature are task issues, which are to what extent a technology is relevant to users' tasks and task performance, and knowledge required for use, which describes to what degree knowledge can be codified and transferred (Greenhalgh et al., 2004). Furthermore, a technology that is provided together with supplements such as for example training, support and customization will be adopted more likely since it facilitates adaption to the organization (Greenhalgh et al., 2004). A summary of the discussed technological factors is provided in Table 1.

5.1.2 Organizational Factors

The characteristics of an organization can be understood as providing the context that impacts the adoption and diffusion of innovations. The characteristics of an organization, i.e. organizational factors, can be divided into structural and non-structural (Greenhalgh et al., 2004). Structural factors include the organizational teaching status, reputation/prestige hospital age, centralization, functional differentiation, external integration, size and organizational resources (Ghodeswar & Vaidyanathan, 2007; Greenhalgh et al., 2004; Kimberly & Evanisko, 1981).

Research shows that teaching status, reputation/ prestige and hospital age are all positive associated with organizational innovativeness. If a hospital is active within research and education, it is likely that the hospital is more innovative and wants to be an early adopter of new developments in the field (Ghodeswar & Vaidyanathan, 2007). Similarly reasoning explains the factor of reputation/prestige; for a hospital that holds accreditations within different fields, it will be important to uphold the status and meet the high expectations by adopting the latest technology within those fields (Ghodeswar & Vaidyanathan, 2007). Hospital age often correlates with teaching status and reputation/prestige. Furthermore, research shows that decentralized decision-making and functional differentiation, where the organization is separated in smaller departments which are to some extent independent, are positively associated with organizational innovativeness (Greenhalgh et al., 2004). External integration is another important factor; if a hospital has good external connections and communication, information about new developments and technology can more easily reach the organization (Kimberly & Evanisko, 1981).

Regarding size there are two contrary perspectives, on one hand large hospitals generally have more resources, such as capital and personnel, which can facilitate adoption of innovations. On the other hand smaller hospitals may be more agile, i.e. less bureaucracy, and more motivated for adopting innovations, as they want to compete with larger hospitals. (Ghodeswar & Vaidyanathan, 2007)

Non-structural factors include receptive context for change and absorptive capacity for new knowledge (Greenhalgh et al., 2004). An organization's receptiveness for change can be understood in terms of strong leadership with clear vision and goals as well as willingness and acceptance of risk-taking and experimentation within the organization. An organization's ability and capacity to absorb new knowledge depends on pre-existing skills and technology in the organization as well as the organization's ability to find, understand, adapt and incorporate new knowledge. In this process, the existence and usage of internal and external networks has an important role. (Greenhalgh et al., 2004) A summary of the structural as well as non-structural organizational factors is provided in Table 2.

One important aspect to discuss related to organizational factors summarized above is the concepts that each factor correlates with. Teaching status and reputation/prestige both correlate to organizational innovativeness, directly affecting adoption of a new technology. The factor hospital age in turn correlates to these two concepts, resulting in an indirect connection to adoption. Other factors with a direct connection are centralization, functional differentiation, size and organizational resources, all correlating with organizational innovativeness. The factor external integration differs, since it does not correlate with innovativeness but rather functions as an enabler by increasing knowledge of new developments among actors in the organization. Finally, both non-structural factors have a direct connection to organizational innovativeness by influencing ease of new technology adoption. As a concluding comment to this section, it is clear that the factors in this area differ in what they correlate with, but when considered together enable a wider understanding. For example, it is useful to not only investigate direct connections to adoption but also indirect ones such as external integration, which determines how knowledge enters the organization. Arguably this factor may be of critical importance even if the connection to adoption of new technology is indirect.

Table 2. Organizational Factors

Organizational Factors
Structural:
Teaching status
Reputation/Prestige
Hospital age
Centralization
Functional differentiation
External integration
Size
Organizational resources
Non-Structural:
Receptive context for change
Absorptive capacity for new knowledge

5.1.3 Individual Characteristics

The adoption process within an organization involves the interplay between several different groups of actors, but still single individuals and their characteristics play major roles in the process (Ghodeswar & Vaidyanathan, 2007). According to Greenhalgh et al. (2004) an individual's needs, values and goals have a strong impact on the adoption decision; if an innovation corresponds to an individuals' needs, values and/or goals the person will be more motivated to adopt it. Thus, the meaning of the innovation for the individual is very important in the adoption decision. This can for example depend on how close a certain problem or benefit is to the intended adopter (Ghodeswar & Vaidyanathan, 2007). Further important individual characteristics are competence and learning style. Depending on if the individual has either the competence to use the innovation or the intellectual capacity to acquire knew knowledge and learn how to use it, he or she will be more or less motivated to adopt the innovation (Ghodeswar & Vaidyanathan, 2007; Greenhalgh et al., 2004).

A necessary factor for adoption is that the indented adopter has sufficient information about the innovation; this is for example information regarding how to use the innovation and the innovation's purpose and functionality (Battista, 1989; Greenhalgh et al., 2004). A decision to adopt will also depend on how much the intended adopter trust the provided information (Battista, 1989).

Another important factor for the adoption decision is an individual's social network. The correlation between social networks and adoption was discussed already in the first diffusion study of medical technology by Coleman, Katz and Menzel (1957), since then the importance of social networks has been well recognized in the literature (Ghodeswar & Vaidyanathan, 2007; Greenhalgh et al., 2004; Kimberly & Evanisko, 1981). Social networks include both contacts within the organization and professional contacts outside the direct work setting. Individuals having large social networks are more exposed to new knowledge and developments within their professional field (Ghodeswar & Vaidyanathan, 2007). The Individual characteristics are summarized in Table 3.

Table 3. Individual Characteristics

Individual Characteristics
Needs
Values
Goals
Motivation
Competence/Skills
Learning style
Information
Social network

5.1.4 Internal Influencers

As discussed above, adoption of an innovation can be related to each individual's attitude and motivation, which in turn is dependent on a number of individual characteristics. However, an individual's attitude towards adoption of an innovation is not solely dependent on those characteristics, other decisions and opinions from management, the group or an influential person in the organization often have a dominant impact. (Greenhalgh et al., 2004)

Opinion leaders are persons that influence the opinions and actions of their colleagues; those persons are often a powerful source of influence for or against adoption of new innovations. Opinion leaders exist naturally in the work setting and it is therefore difficult for the organization to actively set up the engagement of such persons when planning to implement an innovation. (Greenhalgh et al., 2004)

Another important influence impacting the diffusion of innovations within organizations is boundary spanners. Boundary spanners are persons with strong social connections both inside and outside the organization that act as a linkage between the organization and the external environment. It is often boundary spanners that intercept new developments and technologies in the field and introduce them to the organization. (Greenhalgh et al., 2004)

The actual buying process is an important part of the diffusion process within organizations. In this process the buying center have a dominant role. The buying center generally consists of formal buyers as well as the actual users; other key roles are deciders, influencers and gatekeepers. The relative power of the different members often varies and the involvement and activity of each role differ along the stages of the buying process. (Ghodeswar & Vaidyanathan, 2007) In analyzing the structure and relative power of the members in the buying center, the diffusion process within organizations can be better understood. Table 4 summarizes the three discussed internal influencers.

Table 4. Internal Influencers

Internal Influencers
Opinion leaders
Boundary spanners
Buying center

5.1.5 External Environment

Diffusion of innovations within organizations is dependent on various external influences. One such external influence is the market; the clinical needs of the population can incentivize an organization to adopt new technology. Another external influence is professional journals, meetings and conferences, which are all important sources of information about new developments and technologies for a hospital. Those sources of information both act as a source of inspiration and reduce uncertainty regarding new technology (Ghodeswar & Vaidyanathan, 2007). In addition, competition impact an organizations motivation to adopt innovations (Kimberly & Evanisko, 1981) since new technology may be crucial in order to upheld a certain quality and/or reputation that attract patients as well as proficient labor (Teplensky et al., 1995). Finally, a hospital can be pushed to adopt new technologies through regulatory laws and political directives (Ghodeswar & Vaidyanathan, 2007; Greenhalgh et al., 2004).

In general a hospital with inter-organizational connections and networks are more likely to adopt an innovation. Hospital uses its connections with other organizations to compare if others already have or plan to adopt a certain technology. In other words, external organizations are commonly used as references and have strong impact on the adoption decision. (Greenhalgh et al., 2004) The factors related to the external environment are summarized in Table 5.

Table 5. External Environment

External Environment
Market
Journals, meetings, conferences
Competition
Regulatory laws
Political directives
Networks and external connections

5.1.6 Organizational Processes and Implementation

Implementation is a crucial part of the diffusion process; implementation comprises the activities that follow up and realize the decision to adopt. Research on diffusion of medical technologies has identified a number of factors that are associated with successful implementation; these factors are closely interlinked with many of the organizational and individual characteristics described above.

It is important that an organization has processes that support and facilitates implementation of new technologies. For example, as discussed under organizational factors, decentralization of strategic as well as operational decision-making down to departments and even teams enhances the implementation (Ghodeswar & Vaidyanathan, 2007; Greenhalgh et al., 2004). Further, dedicated resources specifically for the new technology increase the likelihood of the technology being implemented. Support from top management, actively involved leaders and clear goals also enhance the success of an implementation (Ghodeswar & Vaidyanathan, 2007; Greenhalgh et al., 2004; Van de Ven, 1991).

Table 6. Organizational Processes and Implementation

Organizational Processes and Implementation
Decision-making
Dedicated resources
Leadership
Training
Communication and feedback
Implementation strategy
Routines

As discussed earlier, the adoption and usage of an innovation in an organization is dependent on the individuals' motivation and skills. Hence, in order to facilitate the implementation of an innovation, an organization should dedicate time to involve, motivate, and train users. Successful implementation of an innovation also requires clear internal communication and continuous feedback about implementation process; how it progress and how it affects the organization and its employees. (Greenhalgh et al., 2004)

According to Van de Ven (1991) there are two general strategies for implementing a new technology in an organization, start small and spread the technology incrementally or do full implementation from the beginning. Research have found that the latter strategy is often more successful than the first. In applying the first strategy there is a risk of lost attention to the new technology; as soon as the technology is introduced in the organization, top management changes its focus to other urging activities, the new technology falls in the dark and the routines go back to normal. While with full implementation, top management stays in full control of the implementation process, which increases the likelihood of success. (Van de Ven, 1991)

The implementation of new technology is often challenged by existing routines, which do not fit the usage of the new technology. Therefore, an important part of the implementation process is to establish new routines. As existing behavior is difficult to change, this is often a demanding process that requires active involvement of all users in the organization. Establishment of new routines should be a collective learning process at the team level, supported by a strong team-leader. (Edmondson, Bohmer, & Pisano, 2001) A summary of the discussed factors related to organizational processes and implementation is provided in Table 6.

5.1.7 Summary and Application of Framework

Figure 13 below illustrates the diffusion framework that intends to analyze the adoption and diffusion of medical technologies within hospitals. The framework is built up around six main groups of factors, Technological Factors, Organizational Factors, Individual Characteristics, Internal Influencers, External Environment and Organizational processes and Implementation, that all have an impact on a hospital's decision to adopt and implementing a new technology. The individual factors represents the characteristics of the individual adopters within an organization, the organizational factors provide the context in which a technology is adopted, technological factors describes the character of the technology, the external environment represents all potential influences outside the boundaries of the organization, internal influencers involves influential individuals and groups within the boundaries of the organization and the organizational processes and implementation represents the processes within the organization. The strength of impact each group of factors has can differ from case to case. However, even if one group of factors may be stronger than the others, all groups are relevant in understanding the complete picture of technology adoption and diffusion among hospitals.

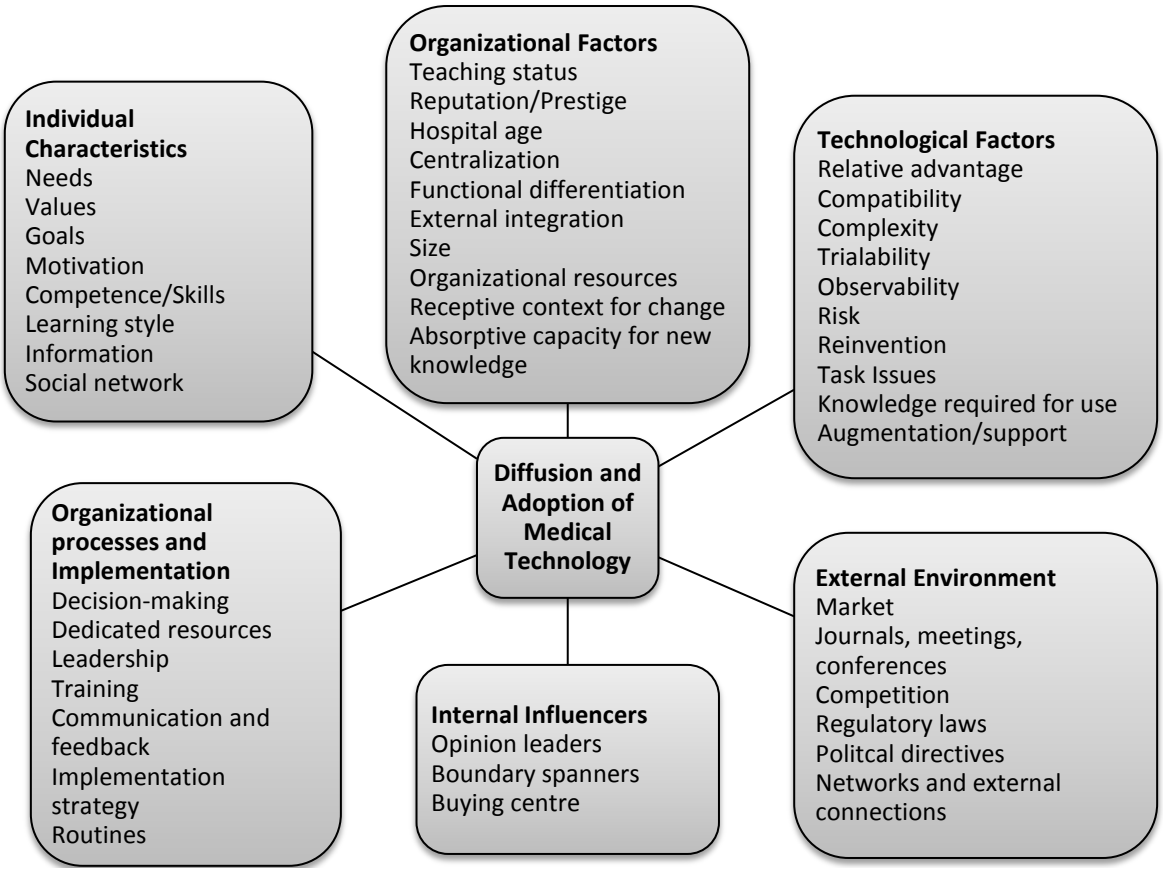

Figure 13. Diffusion Framework for Medical Technologies

The diffusion framework will be applied to the continuation study in order to analyze why some hospitals have successfully adopted and implemented the STAN-method and why some hospitals have been unsuccessful in this process. Initially, each hospital will be analyzed according to each of the factors and factor groups in the framework with the goal to determine which areas are the most relevant to analyze deeper. The determination itself was done through observing in which factor area that the difference between unsuccessful and successful hospitals was largest. The factors and factor groups that here emerge as the most salient will then be given most weight in subsequent analysis. Throughout the analysis, similarities and differences between the hospitals were discussed in order to extract learnings for Neoventa in spreading STAN. Establishing the factor areas that are most important is furthermore critical in order to avoid shallow conclusions arising from failure to narrow the scope of analysis.

5.2 Technology Marketing Model

The previously presented diffusion framework aims to enable an understanding of how a medical technology diffuses within organizations. However, the purpose of this thesis is also to identify the relevant factors for Neoventa in seeking to address experienced barriers to adoption and diffusion of the STAN-method. This part of the purpose cannot be achieved only with an understanding of how a technology diffuses, but must be complemented with an understanding of how a company can influence the diffusion process. One influential body of literature on this subject is technology

marketing, which will be presented here as a technology-marketing model aimed to be used in the analysis phase together with the diffusion framework.

Moore (1991, p.9) argues that special principles apply to the marketing of an innovation that requires a change in behavior from the part of the prospective adopter. One salient character of such high technology markets is the tendency of customers to reference each other when considering adoption. The standard and widely used High-Tech Marketing Model stipulates that one should start with the most innovative adopters in the technology adoption life cycle curve, and then linearly diffuse the product category by category. In effect, each category is used as a reference to convince prospective adopters in the next category (Moore, 1991 p.13). However, the technology adoption life cycle, illustrated in Figure 14 below, is unique in the case of innovative products, and not linear such as in the High-Tech Marketing Model. Each psychographic group of adopters in the curve has a different motivation and decision process and will not adopt the innovative product if it is presented similarly as to the previous group (Moore, 1991 p.15). This results in an adoption curve with gaps, where the largest being the gap between the early market and the mainstream market; named "The Chasm" (Moore, 1991 p. 18). The Chasm exists since visionaries and pragmatists are looking for different things when adopting an innovative product. The former seeks a discontinuous change with the potential for a large improvement, whereas the latter seeks a proven and incremental improvement. These two types of customers respond to completely different sets of arguments. This means that a company marketing an innovative product cannot use its early customers (visionaries) as reference to the larger mainstream market; causing the chasm. The challenge in this kind of market is effectively that the firm must supply references to mainstream customers but only possess references that are deemed unacceptable by these customers (Moore, 1991 p.19).

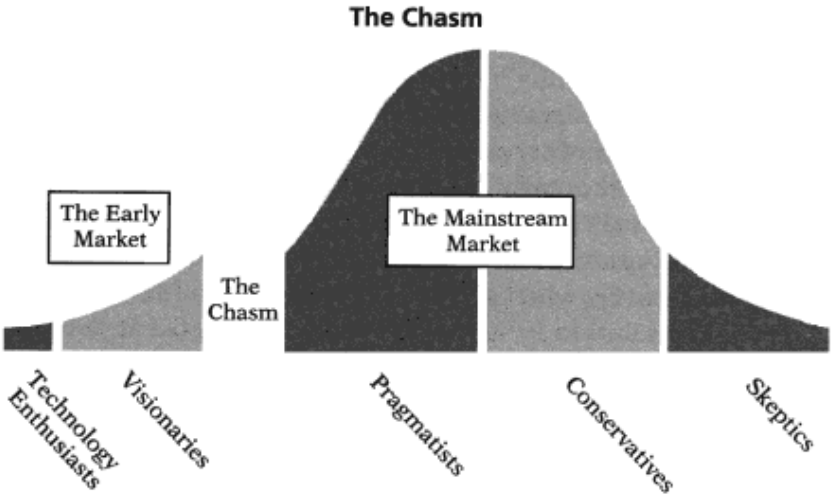

Figure 14. Revised technology adoption life cycle for innovative products (as presented in Moore, 1991 p.16)

In order to "Cross the chasm", a firm must choose a very specific target in the mainstream market and dominate it. After this, the conquered target can be used as a reference base to capture remaining mainstream customers. The logic of this approach is to overcome the reference-based adoption characteristics of technology markets by focusing all resources on a specific target. The more tightly bound members of similar professions or interests in the target niche are, the more they will contribute to spreading the message and, therefore, the easier it becomes for the technology firm to conquer the niche (Moore, 1991 p. 64). One approach that is often seen in technology firms,

and that is likely to be unsuccessful, is to attempt to introduce the innovation in many different targets simultaneously. An example is to convince 10 customers, each in a different segment, rather than 5 in the same segment. This causes a problem since there are no reinforcing effects occurring between the adopters of the technology. In turn, this is due to the fact that the adopters are not closely enough connected to each other (Moore, 1991 p.66). In fact, unpredictability in sales has been identified as a result of a lack of focus in technology markets (Moore 1991, p.67).

However, picking the right target is not enough to overcome the difficulties of technology markets. The firm must also ensure that the whole product is delivered to the customer. The whole product is the set of all products and services that are required by the customer to achieve the indented result. The whole product concept is illustrated in Figure 15 below. Examples of services include system integration and education (Moore, 1991 p.66). A consequence of not focusing and not delivering the whole product is that it is difficult to convince customers that they are adopting a future standard, or supporting the future market leader, in the industry. Mainstream customers typically expect their technology supplier to achieve such a position, since it reduces the perceived uncertainty of adoption. Another reason for this expectation is that whole products tend to grow around market leaders (Moore, 1991 p.68).

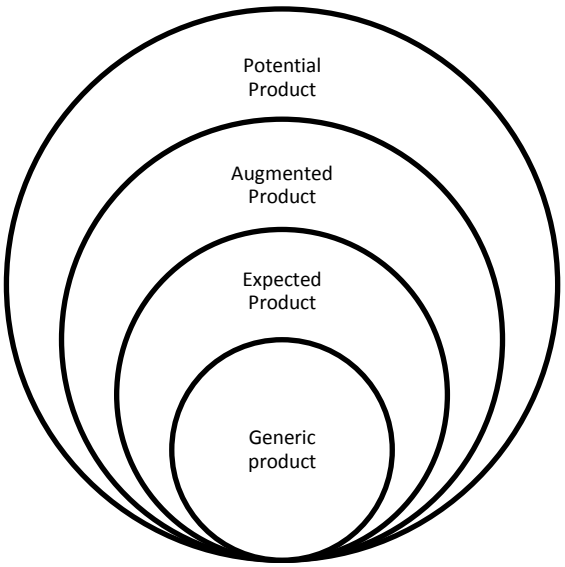

Figure 15. The whole product concept (as presented in Moore, 1991 p.105)

As a result of customers' requirement of a whole product and market dominance, the only adequate strategy for a technology firm is to be a "big fish in a small pond", meaning that resources are focused to become a dominant player in a smaller market space. Once this has been achieved, the company can leverage references from conquered smaller market spaces into adjacent ones, thereby increasing market penetration (Moore, 1991 p.69).

Applied to medical technology, target segments are likely to be not only technical application niches but also geographical ones. The determinant of a good target according to the above is how tightly bound members of the niche are. Since a hospital department provides a close social setting for clinical professionals of the same specialty to interact, it qualifies as such a target. The whole product in the case of medical technology is, due to complex nature of the technology, likely to include education.

The Technology Marketing Model is illustrated in Figure 16 below, and will be applied to findings from internal interviews with key Neoventa salespeople responsible for marketing and selling the STAN-method. Through such an application, the Neoventa sales model can be compared to the Technology Marketing Model. Following this, advantages and shortcomings of the currently employed sales model by Neoventa can be discerned, and potentially beneficial changes identified. Further, the employed sales model understood in relation to the Technology Marketing Model contributes to understanding reasons for difficulties in overcoming adoption and diffusion barriers at the Swedish market.

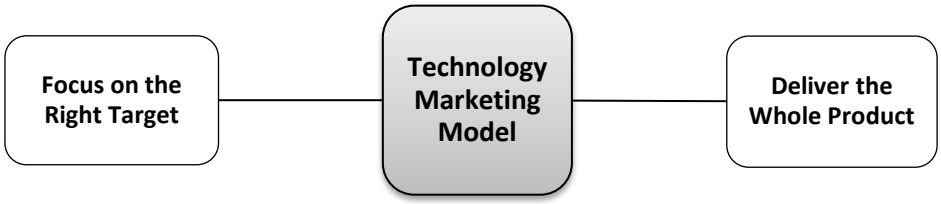

Figure 16. Technology Marketing Model (Moore, 1991)

5.3 Application of the Theoretical Framework

In the forthcoming analysis phase, empirical findings will be synthesized with the theoretical framework developed in this section, consisting of a combination of a diffusion framework for understanding the dynamics of medical technology diffusion and a Technology Marketing Model. The analysis will begin with a breakdown of empirical findings based on the six diffusion framework areas that impact the diffusion of a medical technology. These areas will enable an understanding of the experienced barriers to adoption and diffusion, which manifest themselves in terms of the identified pilot study parameters. The Technology Marketing Model will then be added to the analysis in order to fully address the purpose of this thesis, which is not only to understand the barriers but also to identify relevant factors for Neoventa in seeking to address them. The dual theoretical perspectives hence function in a sequence of first understanding the barriers and then generating a picture of Neoventa's possibilities in addressing them, both of which constitute the purpose of the present study.

6. Exploratory- and Pilot Study Findings

This chapter presents the results from the exploratory- and pilot study. The exploratory study was performed with employees at Neoventa Medical. The pilot study consisted of interviews with key stakeholders at four different hospitals in Sweden. The results are followed by an analysis in relation to the pilot research question "What barriers to adoption and diffusion of the STAN-method exist, and what is their implication for Neoventa in spreading STAN?" as well as implications for the focus of the continuation study.

6.1 Exploratory Study Findings

Exploratory interviews with employees at Neoventa were held on the topic of experienced barriers to adoption and diffusion of the STAN-method (Interview 27). The interviews significantly increased the understanding of the fetal monitoring field and Neoventa's overall concerns. The study resulted in identification of the parameters in Table , which the respondents believed to be causing adoption and diffusion barriers of the STAN-method:

Table 7. Possible Barriers to Adoption and Diffusion of the STAN-method

Parameter	Main Question
Time	How does the STAN-method affect the time it takes to perform daily tasks?
Complexity	How does the STAN-method impact complexity of the working process at the hospital?
Usage	How is the STAN-method experienced from a usage perspective? Is the STAN-method considered easy or difficult to use?
Product placement	How does the STAN-method's medical device fit into its intended surroundings?
Responsibility	Does the STAN-method imply any redistribution of responsibilities at the hospital?
Clinical benefits for the patient	What benefits for the patients does the STAN-method provide?
Decision-making support	Does the STAN-method impact employees' abilities to deliver a good treatment to patients?
Training	Does the STAN-method require more or less training compared to other medical devices or methods?
Knowledge	Does the STAN-method impact knowledge regarding delivery of babies, fetal physiology and fetal monitoring in general?
Maintenance	Is there any difference in maintaining the STAN-method's medical devices in comparison to other devices?
Cost	How are the clinic's costs affected by using the STAN-method?
Purchasing process	What did the purchase process look like in the case of the STAN-method?

6.2 Pilot Study Findings

The interviews with key stakeholders at four hospitals provided a more comprehensive understanding regarding what parameters are causing adoption and diffusion barriers and are thus important in understanding adoption behavior at hospitals. Below follows a presentation of the interview findings from each of the hospitals according to each of the identified parameters in the exploratory study. Initially and for each hospital, a background is given to provide contextualization.

6.2.1 Ryhov County Hospital in Jönköping

The maternity care unit at Ryhov has 8 STAN devices and is fully converted to STAN. The clinic uses STAN during all deliveries. Ryhov became aware of STAN during the 80-90s when the method was used at Linköping's University Hospital; during this time the method was disputed and the method's inventor considered controversial. Later, a study showing the relationship between the STAN-method and decreased risk for metabolic acidosis eventually captured Ryhov's real interest. (Interview 1)

STAN was introduced at Ryhov around 2004 when two initial devices were bought for trial. Ryhov found it appealing that Neoventa did not only provide a device, but also a training package (Interview 1). Therefore, in relation to the two first devices, Ryhov initiated a major training effort, educating midwifes as well as obstetricians and gynecologists. The training in ST analysis was bought from Neoventa and included education in how to interpret CTG-curves. Ryhov recognized that interpreting CTG-curves was an area in which they needed to continue to increase their knowledge, and therefore initiated further internal trainings. Midwifes, obstetricians and gynecologists were all trained together resulting in very good collaboration between the types of clinical professionals. In addition, when STAN was implemented, Ryhov established guidelines and routines on how to use the method and how to adapt it to the daily work. The guidelines have had a very positive impact on work at the clinic. (Interview 2)

The training in CTG together with ST analysis was a major lift for the clinic. (Interview 2) In order to gain and sustain competencies in CTG and ST analysis Ryhov realized that they needed to increase the number of STAN devices at the clinic, and start using them on a daily basis and on all deliveries. (Interview 1 and 2) Around 2010 the clinic was fully converted to STAN. Ryhov has kept a strong focus on CTG training and holds training sessions (30-40 min) every morning when conducting patient rounds. These training sessions are also aimed at assistant nurses (Interview 2). Further, Ryhov requires all midwifes and doctors to have a CTG license, which has to be renewed every 18 months (Interview 1 and 2).

According to Ryhov, the process of adopting and implementing STAN was not very difficult; the clinic has generally had a positive attitude to new technologies and enjoys being a pilot clinic for novelties. Ryhov is constantly working hard for improving its health care and in 2013 Ryhov was appointed Sweden's best hospital in the category of medium-sized hospitals. (Interview 2) In addition, Ryhov can be considered as a sufficiently small clinic where everyone knows each other by name. The clinic has low employee turnover and the work is performed in tight teams. From the informal view, there exists little hierarchy and all employees are considered at the same level. (Interview 2)

Ryhov has very positive experiences of the STAN method. The few disadvantages mentioned relate to technology in general: when using a lot of technology, humans risk interfering in matters which nature may handle better on its own. Indeed, there are some midwifes that are skeptic to the use of too much technology. (Interview 1)

When Ryhov was asked how they considered STAN in relation to each of the parameters, the view presented in Table was given:

Table 8. Ryhov's Perspective on the Barriers to Adoption of the STAN-method

Time	Initially there may be a period of learning when the STAN-method requires more time However, once the user is confident with the method, there is no difference in time required using STAN compared to any other method (Interview 1). STAN can result in timesaving as midwifes are more observant in interpreting the data and as it is easier to make decisions when more information is available. (Interview 2)
Complexity	The complexity increases for every new activity or technology that is added, especially during the learning period, so also for the STAN-method. For someone that is not used to STAN, it can be very complex and stressful, for example a midwife may summon the doctor at every new STAN event. But again, as the user becomes more confident with the STAN-method, the complexity decreases. Today, STAN is rather viewed as a technology that facilitates and provide increased safety for the user. (Interview 1)
Usage	The same answer as for complexity; initially the usage may seem more difficult, but as soon as the learning period is over, there are no major differences in usage or handling compared to other methods. (Interview 1)
Product placement	N/A
Responsibility	STAN does not impact distribution of responsibilities between midwifes, doctors or other personnel. STAN provides more distinct directives on when the midwife needs to consult a doctor, resulting in doctors being summoned less. There is of course a risk that the doctor is consulted too seldom. (Interview 1)
Clinical benefits for the patient	The STAN method does not result in any dramatic effects on the health status of mother and baby since the maternity care in Sweden is already very well developed. But still, STAN has contributed to some improvements at the clinic: fewer babies are born with metabolic acidosis and the usage of obstetrical vacuum extraction suction cup has decreased. However, no effects has been traced to the number of caesarean sections, which otherwise is a major selling point for Neoventa. (Interview 1 and 2) Ryhov believe in that "thousand babies need to be monitored in order to save one" (Interview 1)
Decision-making support	Using STAN midwifes and doctors are provided with more information to support decisions and actions. (Interview 2)
Training	Training required for STAN is perceived as higher compared to other devices. (Interview 1 and 2)
Knowledge	A clear positive side effect of implementing and using the STAN method is the increased knowledge on how to interpret CTG. (Interview 1 and 2)
Maintenance	There are no major differences in maintenance compared to other devices. (Interview 4)
Cost	STAN requires an initial investment but this investment is repaid both immediate, as fewer FBS is needed during deliveries and later in time as fewer children need treatment for metabolic acidosis. (Interview 1) Generally, it does not matter if the technology costs 5 SEK or 100 000 SEK as long as it used by the personnel and provides benefits to an equal value. (Interview 3)
Purchasing process	The buying process was initiated by the chief of medicine who prepared a balanced score card showing the potential benefits of the STAN method, i.e. the medical results, customer satisfaction and cost-effectiveness. (Interview 1) The proposal was investigated further by the department management group and in consultation with the personnel, the director of the department ultimately decided to adopt the STAN method. Purchase decisions are always taken in consultation with the personnel, since it is important to engage and have the support from end-users of the technology. (Interview 3)

6.2.2 Norra Älvsborg County Hospital (NÄL) in Trollhättan

The maternity care unit at NÄL has three STAN devices and uses STAN only on high-risk deliveries as a supplement to CTG. STAN was introduced at NÄL in 2001; at that time the clinic had STAN devices installed in five delivery rooms. However, on the occasion of next procurement, STAN was considered too expensive to install in all delivery rooms as it was only used on high-risk deliveries. Therefore NÄL decided on having two mobile devices and a third fixed device installed in one of the delivery rooms. (Interview 5)

When introducing STAN, NÄL began an effort to continuously train all personnel but today the focus on training has decreased, and trainings are not held as regularly as desirable. (Interview 5) Still, NÄL requires that all midwifes and doctors are trained in STAN and hold a CTG-license (Interview 5 and 6). Assistant nurses should know how to handle the STAN device but do not need to know how to interpret the data (Interview 6). As the focus on trainings has been lower over the past years, new doctors and midwifes are not as competent in STAN and CTG as their older colleagues are, and sometimes have to seek help. In relation to infrequent trainings, the usage of STAN has gone through a dip, resulting in some midwifes losing their competence and confidence in using the method. At the moment, the clinic is trying to increase use of STAN to reverse this trend. (Interview 5)

The maternity care unit at NÄL believe in "natural" deliveries to the largest extent possible. If the period of pregnancy has been normal and without any complications, no technology is often needed during the delivery, not even CTG monitoring. The delivery should not be distracted with lots of technology, as it may result in points of disruption and stress. (Interview 5 and 6) Employees referred to studies that have shown that CTG does not result in any major positive effects during deliveries and that it can actually distract the delivery process as it causes over-interpretations and identification of non-problems, which worry the mother and father. (Interview 6) It is a common view that deliveries should be free from technology. NÄL wants to monitor on indication, which means that monitoring is only introduced when there are deviations and indications of risk. (Interview 5)

According to NÄL the main disadvantage of STAN is that the method is equivocal (Interview 5 and 6). When STAN was introduced, there existed a major overconfidence in the method but soon midwifes realized that it could not give any clear answers resulting in frustration. Some doctors and midwifes do not think that the method contributes to the delivery process (Interview 5). As STAN is based on CTG, it requires a substantial amount of knowledge both regarding CTG and regarding ST analysis. The knowledge needed is perceived as complex and many midwifes feel insecure when using the method. (Interview 5 and 6) Especially frustrating is when STAN is signaling despite the baby appearing to be doing well according to CTG monitoring. In the beginning, when the STAN was introduced, there were some concerns regarding technical issues, such as low-quality signals. It was very frustrating for the midwife when the technology was not working since patients became worried and stressed. (Interview 6)

When NÄL was asked how they considered STAN in relation to each of the parameters, the view presented in Table was given:

Table 9. NÄL's Perspective on the Barriers to Adoption of the STAN-method

Time	Using STAN does not require extra time in comparison to other methods. (Interview 5 and 6)
Complexity	STAN implies a higher degree of complexity, as it requires that all users are well trained and know how to understand the information. (Interview 5) The complexity of the method leads to uncertainty among midwifes who do not feel confident with the method and, generally, those midwifes need to consult the doctor more frequently. Furthermore, as with technology in general and not only with STAN, there is a worry regarding the reliability, i.e. if the technology will work or not when needed. There are many parts of the technology that can malfunction which can be very stressful for the employee as well as for the patient. (Interview 6)
Usage	The same answer as for complexity.
Product placement	N/A
Responsibility	STAN does not lead to any major differences in responsibilities. However, using STAN can increase the need for consultations with the doctor, especially if the midwife is inexperienced with the method. (Interview 5 and 6)
Clinical benefits for the patient	NÄL has not seen any significant effects of their usage of STAN. Generally, it is very difficult to measure the benefits since there are a large number of parameters that affect the outcome of a delivery (Interview 5 and 6). However, studies on STAN show clinical benefits such as reduced metabolic acidosis and reduced need for FBS. It is mainly due to these studies that NÄL uses STAN. (Interview 5)
Decision-making support	The chief of medicine identifies the personnel as divergent regarding this parameter. Around half of the users are positive to the STAN-method and view it as a support when making decisions. The other half is more negative; they feel concerned when using it and do not think that the method helps them make better decisions. (Interview 5)
Training	STAN requires much training and it is, in particular, very important to be competent in using CTG since the STAN method is based on CTG. (Interview 6)
Knowledge	Maternity care in general in Sweden has had great advantage from increased knowledge of CTG, which STAN has contributed to. (Interview 5)
Maintenance	There is no difference in maintaining STAN devices in comparison to other devices. (Interview 8)
Cost	STAN devices are twice as expensive as normal CTG devices and, according to (Interview 6), the clinic does not want to spend money on more technology but on more personnel that can be present during deliveries. The clinic has completed a survey showing that a well-perceived delivery is mainly dependent on competent coaching from personnel. (Interview 6) According to the head of department of obstetrics and gynecology, cost alone is not the main driver in purchasing decisions. Cost needs to be considered in relation to the potential benefits. As long as a method or technology can lead to significant clinical benefits; patient safety, cost-savings or shorter treatment time, cost matters little. If a method above budget, the department can apply for money from the hospital management. (Interview 7)
Purchasing process	The initiative to introduce STAN was led by the chief of medicine and the chief midwife, which usually are the two driving forces behind new methods and technology at the clinic. The chief of medicine has strong influence regarding which methods to use, while the chief midwife has the economic responsibility. (Interview 5) The chief of medicine prepares a proposal on the new method or new technology, including motivations to why it should be implemented and what benefits it can provide to the clinic. The proposal is presented to, and further discussed with, the management group of the department. The final buying decision is made by the head of department. (Interview 7)

6.2.3 Skåne University Hospital in Malmö and Lund

The maternity care units at Skåne University Hospital in Malmö and Lund do not use the STAN method. Although, the clinics own several STAN devices, which have previously been used, the clinics have today chosen to discontinue use and place the devices in the basement. Instead the clinics rely on CTG and FBS lactate measurements.

The maternity care unit in Lund was one of the clinics that were involved in early trials and initial development of the STAN-method when it first was introduced on the Swedish market. The clinic in Lund was part of the Swedish RCT, a study that was later criticized for containing manipulated numbers regarding the STAN method's clinical effects. After participation in the study and the trials of STAN, Lund started to successively remove the devices from usage. The reason was the publication of a number of unreliable studies regarding STAN and its effects. For example, the inventor of the STAN-method was part of one of the studies, and due to his economic interest in the method, this study was thought to be less objective. (Interview 9)

Neoventa was quite aggressive in its early marketing of the STAN-method saying, "STAN is the answer to everything" and "Stop using CTG entirely". At the beginning, Lund trusted the message but after a while it appeared cases when STAN had not warned in time and babies were hurt. This made the clinic in Lund take the decision to stop using STAN. In addition, a multi-centric study on STAN performed in Lund showed that the method did not result in any benefits for the clinic; it did not reduce the number of caesarean sections nor the number of babies born with metabolic acidosis. According to Lund, the reason to the low effects of STAN was the fact that the clinic already had very good knowledge regarding CTG. Hence; STAN did not provide much improvement. In addition, Lund admits they may have used STAN incorrectly. The aim from the beginning was to use STAN on all deliveries; nevertheless the STAN devices were randomly distributed between the delivery rooms resulting in no consistence in how, when and on which patients to use them. (Interview 9)

Today the major reasons to not use the STAN method at the clinic in Lund is: (1) The device warns when hypoxia in the brain already is surveyed, which is to late, (2) the method is based on CTG which is a rather unreliable method in itself and in addition to the unreliable CTG, further doubtful methods have been added. (Interview 9) However, the choice to exclude STAN is not apparent. According to Lund there might be a need to use STAN at high-risk deliveries as the method provides an extra piece of information. The reason to why this idea is not implemented currently is that no one has taken the initiative. Even if doctors may think it is a good idea, it is usually midwifes that chose which methods are to be used when the patient arrives at the clinic. Doctors are consulted much later, when the delivery is already in progress and it may be too late to change method. (Interview 9)

The implementation of STAN at the clinic in Malmö, initially met a resistance among midwifes but was followed by a period of positive experiences with the method. Later, the STAN devices were removed almost overnight; this was partly due to the debate in media regarding unreliable studies and partly due to the employment of a new chief of medicine at the clinic. (Interview 11) According to obstetrician (b), the decision to remove STAN can be questioned since the STAN-method is much more supported by research than competing methods such as CTG and FBS.

According to obstetrician (a) there exists a common aspiration for using as little technology as possible in maternity care while still ensuring safety for the patient. Many women want to give birth

as naturally as possible, without too much technology and drugs. The ultimate decision on which routines to follow lies with the specific clinic and thus varies extensively.

Interviews reveal that opinions regarding the STAN-method are diverging among the doctors working at Skåne University hospital. When Skåne University Hospital in Lund and Malmö was asked how they considered STAN in relation to each of the parameters, the views presented in Table were given:

Table 10. Skåne University Hospital's Perspective on the Barriers to Adoption of the STAN-method

Time	There are no major differences in time when using STAN. On one hand, the doctor might be consulted more often regarding STAN events (Interview 11) and it may take more time to interpret the information (Interview 10). On the other hand, the method also decreases the need for measurement activities such as FBS, which results in timesaving. (Interview 11)
Complexity	According to obstetrician (a) the complexity increases when using STAN, since more data needs to be considered. Obstetrician (b) agrees with obstetrician (a) that more information can result in increased complexity, especially since STAN sometimes provides contradictory information that needs to be carefully interpreted. However obstetrician (b) states that more information also gives a more true and reliable representation of the situation.
Usage	The answer is the same as for complexity.
Product placement	N/A
Responsibility	In theory, STAN does not imply any changes in responsibility between midwifes and doctors but, in practice, doctors are consulted more often due to difficulties in interpreting STAN data. (Interview 10 and 11) Also, when STAN was still used, the method was aimed at high-risk deliveries, which requires higher degree of involvement from doctors. That meant that as soon as STAN was used, the midwife handed over the main responsibility for the patient to the doctor. (Interview 11)
Clinical benefits for the patient	According to obstetrician (b) at the clinic in Malmö the use of STAN resulted in reduced metabolic acidosis. However, this effect was not experienced by the chief of medicine at the clinic in Lund. Neither clinic saw any effect on the number of caesarean sections when using STAN. (Interview 9 and 11)
Decision-making support	According to obstetrician (b) STAN served as decision-making support as it provided more pieces of information: "The more pieces of a puzzle, the better decision can be made". The chief of medicine at the clinic in Lund and obstetrician (a) in Malmö do not share this view. The chief of medicine at the clinic in Lund thinks it is hazardous to rely too much on the method, since there is a risk of missing out on important aspects.
Training	The STAN method requires a significant amount of training, especially education on how to interpret and use CTG. The training is perceived as a very positive aspect of the STAN method. (Interview 9, 10 and 11)
Knowledge	The STAN method has contributed to increased knowledge on CTG (Interview 9, 10 and 11) and fetal physiology (Interview 11). According to obstetrician (b) it is worth to consider whether the knowledge level required for STAN is somewhat high for midwifes since they have no background within medicine. (Interview 11)

Maintenance	STAN required slightly more maintenance compared to other devices, this may, however, be explained by the fact that the STAN devices at the clinics were mobile and not installed at one place. In addition, devices were less developed from an industrial engineering point of view compare to devices from for example Philips. The STAN device gave the impression of being somewhat homemade and the device was not optimized to take apart. (Interview 13)
Cost	N/A
Purchasing process	Skåne University hospital participated in a large study on the STAN method and was one of the hospitals that were part of the initial trial and development of the method in Sweden trough the Swedish RCT. (Interview 9)

6.2.4 Stockholm County Council (SLL)

SLL is the only county council in Sweden that has no experience at all in working with the STAN-method. The maternity unit in Södertälje once tried the STAN method. The idea was initiated by driving spirits at the clinic. Södertälje then borrowed STAN devices from Neoventa, trained users and started to use the method. STAN was here well received by doctors and midwifes and the clinic became interested in purchasing STAN devices. Before making any decision to buy, Södertälje however awaited the results from a health technology assessment (HTA) conducted by SLL at the time. Once finished, the HTA showed mainly negative aspects of the STAN-method. Based on the results from the HTA, SLL did not recommend any clinic in its jurisdiction to adopt the method. Many criticized the HTA for not involving the people that had actually been researching the method and thus had the widest knowledge in the case. The HTA and the subsequent recommendation from SLL resulted in no maternity unit in Stockholm adopting the STAN-method. Today, the fetal monitoring methods used in Stockholm are CTG and FBS. (Interview 14)

As SLL has no experience in working with STAN, it was not possible to receive specific answers in relation to each of the parameters. Instead, an overall view of SLL's relation to the STAN-method will be given here based on an interview with an obstetrician, who is one of the original researchers on the STAN-method and who has previously been working at Karolinska University Hospital.

According the interviewee, there are many explanations as to why there is a negative attitude to STAN in SLL. First, the view of the STAN-method is highly influenced by the negative opinions from leading persons in the field of obstetric care in Stockholm. There exists a Not-Invented-Here (NIH) syndrome since the method was not discovered and developed in Stockholm and no hospitals from the region were part of the first RCT studies. In comparison to the rest of Sweden, maternity care in Stockholm is also characterized by large units with many employees. Due to the size of the units it is a challenge to enforce change and train all users in novel procedures. In Stockholm, STAN is considered expensive due to the massive training effort needed to introduce the method. In addition, SLL does not have the tradition of CTG-training as for example exists in Skåne, where CTG-training has been given high attention over the years. This, in turn, made it easier to introduce STAN there. (Interview 14)

During 2002-2003 the interviewee held lectures on STAN in Stockholm, at which point in time the interest was large and mostly positive. However, around 2005, the situation became emotional and skeptics took a stand against the method.

The interviewee finds the relationship between STAN and redistribution of power very interesting and has been doing some qualitative research on the connection. According to the interviewee, STAN shifts some power from the doctor to the midwife as the midwife gets more information on the health status of the baby. This shift in power may be part of the explanation to the opposition to STAN in SLL. The interviewee further clarifies that it is important to distinguish between power and responsibility; responsibilities are defined in the care program of the hospital while power is more subjective.

Finally, in Sweden there exists an overall resistance to using common guidelines in obstetric care, which may influence the success of introducing methods that is based on guidelines and trainings that are common for everyone at a unit of care.

6.3 Interpretation of Results

This section discusses the results of the pilot study in relation to the pilot research question; *"What barriers to adoption and diffusion of the STAN-method exist, and what is their implications?"* The section is divided into two parts; the first part determines the barriers in terms of parameters. The second part presents a comparison between the studied hospitals that intends to demonstrate and analyze the implications of the barriers. The analysis in this section is not performed in relation to theory but is a general discussion of results based on the objective to create a deeper understanding of the problem of barriers to adoption and to decide the focus of the continuation study.

6.3.1 Parameters

According to the hospital interviews not all of the parameters identified during the explorative discussions with employees at Neoventa are critical in understanding adoption and diffusion barriers to STAN among hospitals. Considering time, STAN was generally not perceived as either more or less time-consuming in usage compared to other methods. Further, STAN did not distinguish itself from other technologies regarding maintenance, purchasing process or product placement. Cost was generally not considered an issue as long as the same amount of value was returned in terms of clinical results, cost-savings or other benefits. When it comes to complexity and usage, STAN was mainly considered complex and difficult to use among those who were less trained in the method. As the perception of complexity and usage was closely related to the individual user's skills, those two aspects will henceforth be covered under the parameters related to training and knowledge. Concerning the parameter responsibility the opinions differed, some perceived STAN as impacting the distribution of responsibilities while other not; nevertheless this factor was not expressed as an issue. To summarize, the following eight parameters was found less relevant in understanding adoption and diffusion barriers to the STAN-method and were therefore excluded: time, complexity, usage, responsibility, product placement, cost, purchasing process and maintenance.

Pilot study findings however revealed two new parameters that are important to understand adoption and diffusion barriers at hospitals. The two new parameters were (a) the hospital's underlying philosophy on obstetric care and (b) the common attitude towards technology in general at the hospital. Findings showed that some users believed that deliveries should be as "natural" as possible, with no monitoring; others stressed the importance of monitoring all deliveries. This underlying philosophy is likely affecting attitude towards a technology such as STAN. Closely related to philosophy on obstetric care is the attitude towards technology. The clinics seemed to differ in their enthusiasm to new technology in general, from an innovative to a more conservative approach,

which also likely affect the view on the STAN-method. The process of excluding and adding parameters in order to arrive at an understanding of the nature of adoption and diffusion barriers is illustrated in Figure 17 below.

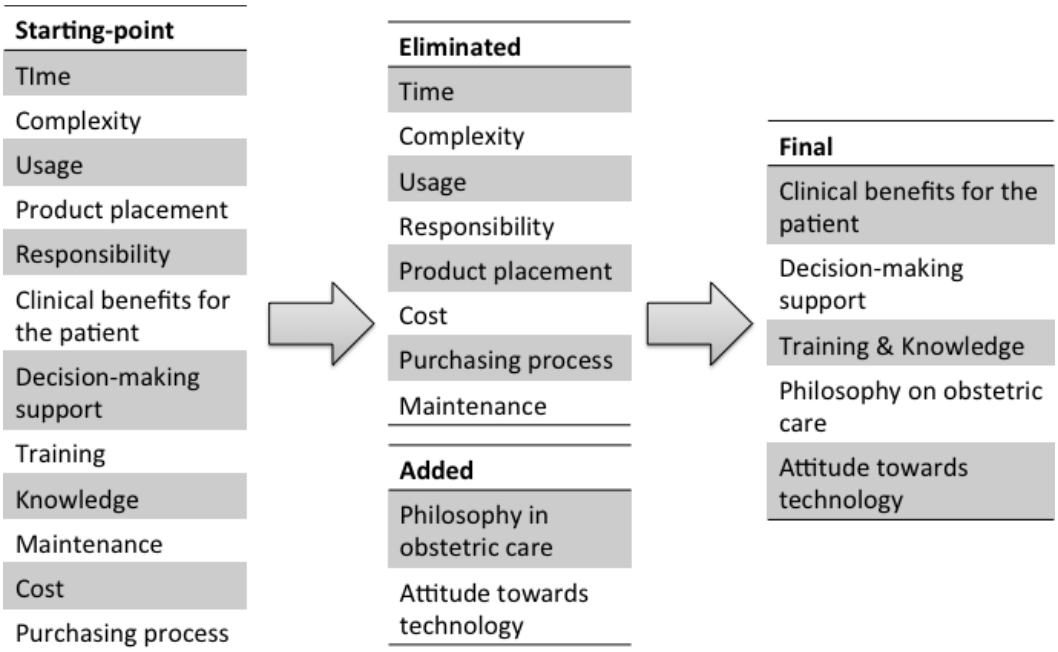

Figure 17. The pilot study process of excluding and adding parameters that define adoption and diffusion barriers to the STAN-method

As eight initial parameters were eliminated and two new added, the following five parameters were then concluded to be important to understand adoption and diffusion barriers to the STAN-method at hospitals: Clinical benefits for the patient, Decision-making support, Training and knowledge, Philosophy on obstetric care and Attitude towards technology.

In analyzing those five parameters further, the hospitals seemed to have a united view concerning training and knowledge as well as clinical benefits for the patient. All hospitals perceived that STAN required more training and more advanced knowledge compared to other methods of fetal monitoring. In return, STAN contributed to increased knowledge on CTG and fetal physiology.

In contrast to this united view, the hospitals' opinions were divergent regarding the parameters of decision-making support, philosophy on obstetric care and attitude towards technology. In analyzing STAN as decision-making support, midwifes less skilled in STAN felt frustrated and confused using STAN, while more skilled midwifes felt more relaxed and believed they could make better decision with the help of STAN. Concerning the underlying philosophy on obstetric care, it became apparent that there existed two opposing philosophies among the clinics, emphasizing ether continuous monitoring or monitoring only after indication. Finally, the hospitals' attitude towards technology in general varied on a range from innovative to conservative, implying that the speed of which the hospitals were willing to adopt new technology seemed to differ.

6.3.2 Comparisons and Implications

Here follows a comparison between the studied hospitals that intend to demonstrate and analyze the implications of the five barriers discussed above.

Ryhov vs. NÄL

At the maternity unit at Ryhov, STAN is used on all deliveries, the work follows established guidelines and the focus on continuous training is high. The personnel expresses a positive view of STAN as a facilitator and a support in their daily work and are not experiencing potential negative effects such as complexity, confusion and frustration in relation to the method. At NÄL however, where STAN is used only on high-risk deliveries and trainings are not held as regularly as desired, around half of the personnel find STAN complex, confusing and frustrating as a method. Further, the maternity unit at Ryhov views itself as innovative and willing to test new technology while NÄL expresses distrust towards technology in general and emphasizes benefits of natural deliveries. As a concluding comment, both clinics have decided to use STAN, which indicates that both clinics are convinced about its potential benefits. However, although NÄL sees potential benefits of the method, the clinic has not been able to realize them to the same extent as Ryhov.

Skåne University Hospital vs. NÄL

There are several similarities between how NÄL experiences and uses STAN today and how Skåne University Hospital perceived and used STAN before discontinuing their use of STAN. At both clinics, STAN was associated only with high-risk deliveries. Regardless of the decision to use STAN on high-risk patients only, there were somewhat unclear guidelines as to when, on whom, and how the method was intended to be used. At the clinic in Lund, STAN devices were randomly distributed among the delivery rooms and at NÄL, midwifes could choose to use or not to use STAN on an unstructured and individual basis. At both Skåne and NÄL, personnel were diverging in their view of STAN, some were positive and some negative but altogether, the enthusiasm towards the method was modest. To summarize, it appears that neither of hospitals are able to realize benefits from the STAN-method.

SLL vs. Ryhov, NÄL and Skåne University Hospital

SLL has no experience in working with STAN, which distinguish them from the three other hospitals. While Ryhov, NÄL and Skåne University Hospital all believe in potential benefits of using the STAN-method, SLL are highly skeptical towards it. In contrast to the other hospitals, SLL shows a NIH bias. Further, the clinics at SLL are large and require a significant training effort to reach a certain level of competence. As to conclude, SLL does not perceive any benefits of using the STAN method.

Understood from the comparison between the hospitals, the implications for Neoventa in spreading the STAN-method are twofold. Firstly, benefits of the STAN-method must be communicated to hospitals. It is clear that, as opposed to Ryhov, NÄL and Skåne University Hospital, hospitals in Stockholm do not see the benefits of the method and therefore choose not to adopt it. However, communication of benefits is not enough for diffusion to be achieved. Hence, secondly, benefits of the method must also be realized at the hospital after the decision to adopt. A case in point is the pilot study hospitals NÄL and Skåne University Hospital, where an adoption decision was made but benefits were not, and are still not, realized. At Skåne University Hospital, this has led to a radical decision to abandon the method entirely. This adverse development after an adoption decision indicates the importance of a focus also on benefit realization, in order to avoid adopting hospitals abandoning the method.

These implications have led to two key insights regarding adoption and diffusion of the STAN-method, which will be presented next.

6.4 Key Insights

A key insight in the pilot study that relates to the first implication, communication of the benefits of the STAN-method, is the great variation in expressed opinions about the method. For example, large differences in opinions existed between Ryhov and NÄL, but also between Skåne University Hospital in Malmö and Lund; two clinics that in fact both belong to Skåne University Hospital. Certain variation in how adopting organizations experience the STAN-method is to be expected due to differences in size and location but also due to individual opinions. However, the level of variation seen in the pilot study is perhaps best described as strong disagreement as to the method's value. This may harm diffusion of the STAN-method because of problems in communicating benefits to new customers. These communication problems manifest themselves because customers in technology markets are keen in referencing each other before an adoption decision and, in the case of STAN, are met with very diverging opinions of the method's value. Hence, it is unlikely in the current case of STAN, that the referencing behavior is successful in reducing uncertainty before an adoption decision and therefore harms diffusion.

A key insight in the pilot study that relates to the second implication, realizing the benefits of the STAN-method, is that other factors than the medical device itself and its functionality are critical determinants of success after the decision to adopt. The discontinuation of use at Skåne University Hospital is a case in point of possible consequences of a customer not being able to realize intended benefits. This leads to the observation that diffusion of STAN requires hospitals to successfully adopt the "whole product" and not just the medical device, even if the device is central.

Addressing the first implication, communicating benefits, involves effective sales and marketing. Addressing the second implication however, realizing benefits after implementation, involves placing focus on a broader set of issues. This is clearly indicated by the pilot study comparison between Ryhov and NÄL, showing that Ryhov unlike NÄL has been able to realize the benefits of the method. Ryhov differs from NÄL in several ways. Particularly, there is a difference in emphasis placed on education and training as well as the implementation and use of the STAN-method. These factors were clearly part of the whole product in the case of Ryhov, and thus support the view that diffusion of the STAN-method must be understood in terms of a whole product. Further supporting this view is the high level of impact the method has had on the three hospitals that have chosen to adopt. Clearly, hospitals considering the method are dealing with a decision that is broader than just installing a new medical device; the STAN method significantly affects how clinical professionals' work.

6.5 Focus of the Continuation Study

To summarize, the pilot study has described adoption and diffusion barriers in terms of the five parameters: Clinical benefits for the patient, Decision-making support, Training and knowledge, Philosophy on obstetric care and Attitude towards technology. Moreover, it has been observed that both benefit communication and realization are critical for successful diffusion. The issue of overcoming barriers of adoption and diffusion can now be described in more detail as how to achieve communication and realization of benefits of the STAN-method at hospitals.

In order to design a continuation study based on the pilot study findings, it is important to note that there are success cases where barriers have been overcome. One of these was included in the pilot study: Ryhov. Success at this hospital has previously been discussed in terms of adoption of the

whole product, something that did not occur at the other pilot study hospitals. However, as hospitals in the pilot study clearly differed in many aspects, one case does not constitute evidence nor provide enough understanding for Neoventa to address their experienced barriers. With this reasoning in mind, a continuation study of other available success cases was designed. In fact, there are several cases in Scandinavia where the STAN-method whole product has been successfully adopted. These are evidences that barriers can be overcome and should be investigated further in order to understand how Neoventa can successfully diffuse the STAN-method.

With these insights in mind, further research questions were formulated that will be answered in the continuation study and subsequent analysis phase of this thesis. The continuation study will focus on understanding how identified and described barriers in the pilot study can be overcome, by investigating hospitals that have successfully adopted the STAN-method as a whole product and comparing those to the unsuccessful cases investigated in the pilot study. In relation to this comparison, Neoventa's sales model will be investigated and analyzed in order to extract insights regarding possible areas of development. While the exploratory- and pilot study answered "*What barriers to adoption and diffusion of the STAN-method exist, and what is their implications?*" The continuation study and subsequent analysis phase will answer the following main research question and two sub questions:

What are the differences between successful and unsuccessful cases in terms of adoption of the STAN-method, and what can be learned from these differences, in order to overcome barriers to adoption and diffusion of the STAN-method at hospitals in general?

- *How have barriers to adoption and diffusion of the STAN-method previously been overcome in individual success cases?*
- *What is Neoventa's sales model for spreading STAN?*

7. Continuation Study Findings

This chapter presents the findings from the continuation study. In the first part, sales personnel at Neoventa give their view of Neoventa's Sales Strategy. This is followed by five cases that illustrate successful adoption and implementation of STAN at five different hospitals. The aim of this chapter is to answer the two sub questions: "How have barriers to adoption and diffusion of the STAN-method previously been overcome in individual success cases" and "What is Neoventa's sales model for spreading STAN?"

7.1 Neoventa's Sales Strategy and Process

Here follows a presentation on Neoventa's overall sales strategy, sales process and implementation, including illustrative examples on how sales are performed in specific markets where the sales work has been proven particularly successful. The findings are based on interviews with the sales director at Neoventa, the business unit manager for BeNeLux and the sales manager for Norway.

7.1.1 History and Current Sales Strategy

Neoventa's sales strategy has been varying over the years. In the early times of Neoventa, as part of an aggressive expansion strategy, the company focused on direct sales, establishing subsidiaries in important markets worldwide, for example in France and USA. However, as the cost of upholding the sales subsidiaries were high the strategy was not sustainable in the long term. Neoventa was eventually force to close down divisions and change strategy to indirect sales in the majority of markets, which is less costly. Today, Neoventa has direct sales in Sweden and France, while their other markets are reach via indirect sales through partners and distributors. Since the head office was located in Sweden, it was possible to keep direct sales in Sweden, it was also seen as important to be present with direct sales on the home market. Direct sales were also kept in France partly because of issues with unreliable partners and partly because France is the single largest market in Europe. The sales partners receive support from Neoventa but also do a lot of work by themselves. Recently Neoventa decided to initiate direct sales also in Norway and Denmark, which are two markets that are almost fully converted to the STAN-method. Due to the success on those markets, it becomes more motivated for Neoventa to control the market directly in order to reach higher margins and also, the risk of establishing a subsidiary is considered low. (Interview 19)

Over time Neoventa has evolved from a highly research-oriented company believing it is unethical to charge money for the STAN-method and make profit on an innovation that so many people can benefit from, to become more commercially orientated in its approach. (Interview 19) During this time of evolvement, there has been a degree of ambiguity in the overarching sales strategy at Neoventa; the exact objective with the product and what it is aimed to be for users has been shifting. Initially, Neoventa aimed to sell knowledge in the form of ST analysis. Such a strategy entailed not only selling a product but also convincing the customer to adopt the entire method, including education, implementation and support. Super-users, meaning very knowledgeable users, and centers of excellence, meaning hospitals that have high level of knowledge about the method, were also critical parts of this strategy. However, this strategy was later abandoned in favor of a more commercial approach. This alternative attitude entailed more focus on sales of products, rather than knowledge. This proved unsuccessful, and Neoventa has recently reverted back to more focus on selling knowledge in the form of an entire method. (Interview 21)

Due to the initial orientation towards research, the internal resources allocated to sales and marketing has historically been small. However, as Neoventa is becoming more commercially focused, the sales work has been given more attention. Still the sales resources are limited. (Interview 19)

7.1.2 Reference-based Selling

According to the sales director at Neoventa, the key factor for entering and establish the STAN-method on a new market is reference-based selling. Reference customers are the strongest ambassadors for the method and are highly important and influential on other hospitals' buying decisions. However, creating reference customers has over the years been a challenge for Neoventa. Previous, Neoventa has been lacking a consistent sales approach and have for long been selling single products to a large number of hospitals, not focusing on converting the whole clinic. A single product at a hospital often results in insecurity regarding the method among users. Today, Neoventa has realized that this is not a suitable approach for establishing reference customers. When entering new hospitals today, Neoventa wants to sell more than just a single product and create reference centers that can be used in reference-based sales later. (Interview 19)

Investigating the spreading of the STAN-method, it becomes clear that Neoventa has not been able reach any success in large countries. Successful spreading of STAN is primarily accomplished in smaller geographical areas, where one or few influential individuals or reference clinics have been able to convince the rest. In larger geographical areas, reference clinics have been proven less powerful as it exists groups within groups that have different opinions. For example the southern and northern parts of France do not share the same opinions, resulting in that a reference clinic in France has less effect. (Interview 19)

7.1.3 System vs. Product

From the previous discussion on local centers of excellences, it became obvious that there is a strong need for selling STAN as a system. Selling a "system" or a "concept" which includes education, training, implementation and support is essential, since knowledge is a critical part of STAN usage. In fact, the sales manager for Norway believes that it is impossible to sell a single product in the case of STAN. However, Neoventa has only recently shifted focus back to knowledge and to selling systems, meaning that the company is still not very experienced in this strategy. (Interview 21) According to the sales director at Neoventa, the work is not trivial; and it is often hard to deny a prospective customer from a single-product purchase. Neoventa should do that, but are not yet at that level today; Neoventa could still do much more improvements and work in terms of selling a system instead of a single product. Around 50-60 percent of Neoventa's customers today, can be considered to have too few STAN-devices in order for the method to be perceived as beneficial. (Interview 19)

According to the sales manager for Norway, the success in markets such as Norway and in Denmark has among others been due to the local sales function have never completely abandon the initial thought of selling a system, thus when Neoventa shifted to a more system selling approach, they were able to quickly return to thinking in terms of systems and concepts rather than products. In Norway there are currently 180 Neoventa units in clinical use. There is only one applicable hospital in the country that has not yet adopted the STAN-method, meaning that market penetration is exceptionally high in comparison to other markets. Some of the concrete actions that have been implemented in Norway and in Denmark to reinforce the knowledge strategy have been to forbid the

customer from purchasing too few products and/or to clearly communicate to a prospective customer that purchasing only one or a few products will not deliver significant benefits. A hospital where the STAN-method is not extensively used is a hospital where knowledge is not diffused or increased, entailing high risk that the use of the method will be discontinued. (Interview 21)

A situation that frequently arises is that hospitals purchase a product on a research budget. According to the sales manager for Norway this is negative, since this budget category is smaller and makes a complete commitment to using the STAN-method difficult. In the opinion of the sales manager for Norway, hospitals must commit further than merely purchasing a unit on a research budget, since benefits form this may be too small to convince the hospital to later increase the number of units. Instead, the case for larger-scale commitment must be made to the customer directly. A good example exists in Denmark, where an early hospital was convinced to commit and to purchase ten units to use the STAN-method on a large scale rather than first testing one. An important thing to consider in such cases is that success is very important for this first customer, since this hospital is watched by all others in the country. The sales manager for Norway believes that this approach is in fact the only way to achieve a complete conversion of a clinic to the STAN-method. In his opinion, a customer will generally not buy more products after a small purchase if the customer has not been completely convinced to commit to the method. (Interview 21)

In Netherlands the sales team has been able to apply a so-called black or white approach, which more or less means that: either the customer buy several STAN from the start or the customer bye nothing. One reason to the possibility of establishing such approach is the fact that the market consists of few large hospitals, around 70% of the hospitals have more than 1000 births per year, which means that the hospitals have the ability to buy several STAN. (Interview 20)

This discussion of commitment to extensive use of the method leads to the question of smaller hospitals. In theory, smaller organizations do not have the volume of patients and births to commit to purchasing and using the STAN-method very much. This is for example apparent in Belgium, which is a market with many small maternity care units; around 70% of the hospitals have less than 1000 births per year. In Belgium, it is common that hospitals only buy one STAN-device at the beginning. However, as only one STAN is not enough to gain full benefits of the method, satisfied customers can later be convinced to buy another one. (Interview 20)

According to the sales manager for Norway, a way to counter the difficulty of few STAN-devices at smaller hospitals and the difficulty of maintaining knowledge, is to promote StanViewerLive software developed by Neoventa. As a small hospital, you can purchase this software and a lower amount of STAN units. Data from these units can then be sent through the software to a larger hospital, or even the center of excellence, for remote consultation. This lowers the hurdle for smaller hospitals to commit to the method, since they have the potential to reach high knowledge without a large number of cumulative births. The membership factor is also very critical in relation to StanViewerLive and to selling knowledge. With large and small hospitals cooperating, a community can be created where knowledge is shared and benefits are reaped by all. According to the sales manager for Norway this has tremendous power for Neoventa in diffusing the STAN-method, since no hospitals wish to be excluded from such a community. (Interview 21)

As a concluding comment, it is apparent that selling STAN as a system or a concept is not trivial. According to the business unit manager for BeNeLux, a potential success factor in improving this

work by Neoventa, is to increase the flexibility on pricing. The pricing should be possible to adapt to the customer and to the situation, for example giving customers discount if they buy mane devices. (Interview 20)

7.1.4 Opinion Leaders

The success of adoption of STAN at a clinic is often dependent on the presence of an instigating, determined and influential person, often a doctor, who can take the lead and motivate and convince its colleagues to use STAN. Those important leaders that are positive to new technologies are not always easy to find; in general, the health care industry is very conservative. However, according to the sales director at Neoventa there exist differences in the attitude towards new technology depending on the age doctors and midwifes. Younger doctors and midwifes are often more willing to try new technology than older, which in turn often is a resisting force to novelties. While influential individuals are crucial in spreading STAN, it is important for Neoventa to not only be reliant on a single person at a clinic but to convince the whole clinic, including all personnel. Otherwise, the STAN-method risks being put aside as soon as the opinion leader leaves the clinic. (Interview 19)

In Norway and Denmark, physicians and midwifes are the most critical people in achieving a purchase decision at a hospital. This is since the midwife uses the actual product while the physician uses its output, making both professional categories closely tied to the method. A challenge in this respect is that midwifes are typically not very enthusiastic about technology. They often believe in natural births. However, this varies from hospital to hospital and no organizational characteristic, such as the hospital being involved in cutting edge research, is a guarantee for an open or closed mind towards medical technology. Because of these and similar hospital-specific differences, it is very important to approach each hospital in a unique way when selling the STAN-method. It is also very beneficial to have a person at the prospective hospital that is supporting the method strongly, since this person may become a change agent. Regardless of any other factors, establishing a good relationship is the single most important aspect of the sales process. It may single-handedly determine the outcome. (Interview 21)

It is not only critical to have a committed individual taking the lead at the hospital, opinion leaders existing in the external environment do also have a significant impact. As an illustration of the effect of external opinion leaders, the main problem for diffusion in Norway and in Denmark has been confusion spread from Sweden. According to the sales manager for Norway, it is very damaging when customers from a neighboring country spread uncertainty, and even in some cases strongly negative opinions about the method. (Interview 21) Furthermore, in Netherlands the opinion leaders have not agreed regarding the clinical evidence, and thus the need of the STAN-method, which makes it difficult for Neoventa to use reference centers as effective as otherwise possible. (Interview 20)

7.1.5 The Process of Sales and Implementation

Except from in Sweden and France, Neoventa sells STAN through partners and distributors. As stated above, those indirect sellers are supported by Neoventa to some extent but are generally rather free manage the sales work how they wish, implying that the sales process may look different for different markets. (Interview 19)

An example of a successful sales process is the process used in BeNeLux, which includes four major steps: The first step involves creating interest at customer through for example STAN newsletters or a meeting at a congress. The target at this stage is often the head of obstetrics or head of

gynecology. The second step is generally a visit at the hospital for a presentation. The presentation is aimed towards the decision-making team, which can, among others, consist of head of obstetrics, purchase manager and a biotech engineer. The presentation generally discusses clinical guidelines, important studies, the technology and support. The sales team must motivate the customer to see the need for STAN, by for example presenting appropriate studies and also showing that STAN can be a protection against medical legal issues. After this presentation, it is often still some hesitations by the customer. Therefore the third step involves a peer confirmation from a key opinion leader at a reference center. Usually, the customer is invited to a reference center for a second presentation that confirms the information presented by the sales person in the first presentation. The fourth step is generally the decision to purchase or not followed by an eventual implementation. (Interview 20)

According to the sales director at Neoventa the most challenging part of the selling process, and perhaps also the most important part, is implementation. From Neoventa's point of view, it is important to from the beginning be honest wit the customer regarding what benefits and improvements that is reasonable to expect from the STAN-method. It is also important to take into consideration the customers' ambition with the method and buying decision. For example, if the customer only decides to buy a single product, Neoventa needs to clarify that a single device may not result in enormous improvements when implemented at the clinic. (Interview 19)

The major challenge with the implementation part, is training. (Interview 19) Knowledge is an essential part of the concept Neoventa is selling to the customer. (Interview 21) Therefore there is a strong need for training efforts from Neoventa's hand. To satisfy the strong need for training, Neoventa would need to establish a clinical training function at the company that has personnel specifically dedicated to this work. The issue of training resources at Neoventa is often discussed as a crucial problem. At the moment, Neoventa has only two person training the customers, one person in France and one in Sweden. It is almost impossible for these employees to be everywhere and train every customer. In addition, it is often not economically defendable to travel abroad to train a clinic that only has bought a single device. As the company lacks enough internal resources for training the customers today, Neoventa tries to find someone at each clinic that can train the rest of the personnel or have the different clinics to train each other. This is where reference clinics play an important role; reference clinics can train other clinics and reduce Neoventa's burden. (Interview 19) Since Neoventa's education is preferably placed at a local center of excellence rather than at Neoventa's office in Sweden, it is very important to ensure the knowledge development at those committed hospitals. (Interview 21) However, the sales manager for Norway is concerned about Neoventa having lost some of its discipline in controlling customers' knowledge development through proper education.

According to the business unit manager for BeNeLux, an ideal implementation involves the following activities. Preferably, all users at the clinic should start using STAN as a basic CTG in parallel with CTG training. Meanwhile, some key users, typically 2 obstetricians and 5 midwives, visit a reference center to get fully-trained and certified on STAN. Those key users will then train the other users at the clinic in using STAN. It is important that Neoventa support the clinic with material such as guidelines, presentations and textbooks. The support from the center of excellence is also crucial. (Interview 20)

7.2 STAN-adoption Success Cases

Here follows a presentation of five cases that illustrate successful adoption and implementation of STAN at five different hospitals. The cases involve three Swedish and two international hospitals: Linköping University Hospital, Mölndal Hospital – Sahlgrenska University Hospital, Halland County Hospital in Halmstad, Oslo University Hospital in Norway, St George's Healthcare NHS Trust in London, UK. All information presented in this section is solely based on interviews.

7.2.1 International Context

In order to assess the applicability of findings from international hospitals, it is relevant to ascertain differences in context that exist between countries. In this study, apart from Swedish hospitals, one hospital from Norway and one from the United Kingdom have been investigated. This means that these two international contexts have to be described in relation to the Swedish context.

In Norway, the main difference in obstetrics compared to Sweden is that fetal monitoring is done on a slightly more conservative basis. This means that monitoring is usually employed less extensively than in Sweden. In most other aspects, procedures related to fetal monitoring are very similar between countries. Specifically, the typical procedure in Norwegian hospitals is to apply an admission CTG, meaning that intermittent CTG monitoring is done when the patient arrives at the clinic. After this, fetal monitoring is typically done only when there is an indication of departure from normal labor. In comparison, Swedish hospitals tend to use fetal monitoring in a more liberal way, generally applying the preferred method on all patients. Nonetheless, there are large differences in procedure between hospitals in Norway, meaning that a general and accurate statement as to the typical way of working with fetal monitoring in the country is difficult to produce. In Norway as well as in Sweden, guidelines for the use of fetal monitoring are set by the national interest organization, such as SFOG (Swedish Association for Obstetrics and Gynecology) in Sweden and NGF (Norwegian Gynecological Association) in Norway (Interview 24).

In the United Kingdom, the main difference in obstetrics compared to Sweden is that scalp blood samples, or FBS, are much less common. In Sweden, FBS is used relatively frequently whereas only very few such samples are taken every year in the UK. One more aspect in which the countries differ is in the specific guidelines that are used for fetal monitoring. Here, there can be minor differences depending on what fits best with the medical procedures in place. For example, in the UK guidelines advise a midwife to call a doctor after one hour with an abnormal CTG. In Sweden, the guidelines recommend a FBS to be executed after the same time. In other aspects, procedures related to fetal monitoring are very similar between the UK and Sweden. However, there are large differences also between hospitals in the UK, both in terms of specific medical procedures that have an impact on fetal monitoring but also on which patients that fetal monitoring is applied. Therefore, it is difficult to draw any specific conclusions as to the general difference between the countries (Interview 26)

From the above discussion on the Norwegian and UK contexts, it can be understood that while the national context influences fetal monitoring practice, no major differences appear to exist. That the differences are larger between hospitals in a country than between countries in both international contexts support the notion that findings in one context can be applied in another. This follows from the fact that other aspects than national context appear to dominate a clinic's choices, including which fetal monitoring methods to use.

7.2.2 Oslo University Hospital in Norway

Oslo University Hospital is using STAN on all risk patients that are admitted to the hospital. Currently, they have five STAN-units; one per room. The level of STAN use is described as very high, as the method is used on roughly 40 percent of all births at the hospital. The overall aim with the method is to use it to complement CTG on births that are deemed risky. The reason for the very high level of STAN use is in turn because Oslo University Hospital is a nation-wide center for risk births in Norway. (Interview 16)

The STAN-method is perceived as the most extensively and best documented method available today for fetal monitoring. In general, there are no major perceived disadvantages. However, a challenge is to ensure that the knowledge level at the hospital is adequate. This is required in order for personnel to correctly use the method. Another potential challenge is to ensure that the method is correctly applied; i.e. that personnel not only are knowledgeable but also use the method in the right way. An example of incorrect use is to have a normal labor process but, upon signals from the STAN-devices mistake the situation as dangerous and immediately conduct an operative delivery. Finally, a challenge is to deal with false negatives, which is a very common issue with fetal monitoring methods. In other words, situations when the device is signaling a warning but no real issue exists must be properly dealt with. (Interview 16)

Oslo University Hospital does not see the STAN-method as definitive, but view it as the best available method today due to its many advantages. Firstly, the STAN-method is perceived to simplify by enabling physicians and midwives to speak the same language. Prior to implementation of the STAN-method, CTG fetal monitoring was done less carefully. With extensive training in relation to impending start of using the STAN-method, personnel were required to use CTG more systematically. STAN added structure to the work in fetal monitoring at the clinic. Furthermore, Oslo University Hospital has observed significant benefits that can be, among other things, attributed to use of the STAN-method, such as low levels of both metabolic acidosis and asphyxia. Another benefit that is perceived is that the method clearly improves decision support by providing better information, effectively enabling a better executing of fetal monitoring at the clinic. (Interview 16)

Decision to adopt

The decision for Oslo University Hospital to initially adopt the STAN-method was perceives as relatively straightforward. In fact, the sequence of events was described as happening almost automatically. Oslo University Hospital was a part of an EU project in 200 which financed large parts of the up-front adoption costs. Resistance to the adoption was at the time perceived as very low. In more detail, Oslo University Hospital first purchased two STAN-devices and later extended the device inventory to five devices. The information that underpinned the adoption decision originated from the Plymouth RCT and the Swedish RCT, of which an overview was presented din chapter 2 of this thesis “The STAN-method”. The main decision-makers were on the clinical side, and clinical effects were the biggest consideration is making the decision. (Interview 16)

Implementation

During the first few months after the initial installation of two STAN-devices, the method was only used on a smaller subset of all potential patients. In connection, frequent tests and recurring evaluations were made to determine the effect of the change. There was a thorough focus during this period to certify personnel in using the STAN-method as well as increasing knowledge and the quality of fetal monitoring work with STAN at Oslo University Hospital. There was, and is still today, a

very strong focus at Oslo University Hospital on quality in connection to fetal monitoring and obstetric care in general. (Interview 16)

A crucial part of the implementation process was education and training. This was especially critical since the underlying method for STAN, CTG, was prior to STAN implementation used less systematically. Education on CTG suffered from a similar problem. Therefore, education and training was truly a major requirement in order to successfully implement STAN. Resistance during the implementation was also low, except for some common reluctance to new technology. Personnel partly expressed that it was complicated to achieve the required certification levels and that it took some effort to learn a new method. Personnel especially expressed that STAN was decidedly more technical than previously used and other available fetal monitoring methods. One aspect that made the implementation process easier was that STAN was not aimed to be applied on all births at the hospital. In Norway, fetal monitoring is only practiced on risk patients, meaning that even a complete implementation of STAN would only affect around 40 percent of births. It was deemed important at the time, in order to minimize resistance, to communicate clearly that the STAN-method would not change the way that fetal monitoring is done. In other words, new technology used on risk patients would not increase the level of monitoring on normal patients, which was a fear at the time of implementation. (Interview 16)

Organizationally, there was a lot of focus and support for the project of implementing STAN, especially on a leadership level. Oslo University Hospital is convinced that these aspects are very important to ensure the success of an implementation project, which means that they attempt to ensure focus, support and leadership in all such projects at the hospital. Specifically and in relation to STAN, early leaders of the project felt that the device risked becoming no more than another device if this approach was not used. Instead, the implementation project has the goal to implement not only the device but a new way to work in fetal monitoring, or a whole new concept of fetal monitoring. The most important aspects that helped the implementation project succeed is widely agreed to be leadership and the fact that a new way of working was implemented rather than only a new medical device. (Interview 16)

Supporting the implementation process, a STAN reference group was established outside the organization of Oslo University Hospital by the Norwegian Gynecologists' Association. This group had the task to provide a second opinion to clinical professionals that has questions of needed support in relation to the STAN-method. This has helped spreading STAN at Oslo University Hospital and in the rest of Norway. The group also organized events, involving information and training on both small and larger scale. The effect has been remarkable on fetal monitoring in Norway. Today, there is a much more extensive and deep knowledge of fetal physiology and a more rigorous focus on being systematic in fetal monitoring in Norway. This change is widely considered very positive among Norwegian clinical professionals. (Interview 16)

The Role of Neoventa

Neoventa had an important role during the purchasing process but also during the implementation of the STAN-method. In the beginning, there did not exist any alternative sources of education, training and knowledge for Oslo University Hospital. Neoventa filled this gap in a very positive manner. Needs were mainly in the form of questions to reduce uncertainty and assistance in determining related aspects such as guidelines for clinical use. Neoventa played an important role in

supporting the growth of knowledge at Oslo University Hospital, from initial purchase to implementation. (Interview 16)

7.2.3 Linköping University Hospital in Sweden

The maternity care unit at Linköping University Hospital has 7 STAN-devices and 5 CTG-devices from Neoventa. Primarily, STAN is used on all high-risk deliveries; the clinic has a list indicating every day what patients that should have STAN. In addition to this, all midwifes can individually chose to use STAN on every delivery they wish. The freedom of choice is highly important and emphasized at the clinic. In case of "normal" deliveries, midwifes are free to choose any method they want to feel as confident as possible in their work. (Interview 17)

The clinic allocates many resources in training. A major training effort on the STAN-method and CTG is held 4 times per year. In addition, specific cases are discussed continuously to share and enhance knowledge among the personnel. The clinic requires the personnel to be certified in both ST analysis and CTG. (Interview 17)

According to the chief of medicine at Linköping University Hospital, STAN is a method with as many benefits and shortcomings as CTG and FBS. At the clinic at Linköping University Hospital no method is considered superior to another, STAN, CTG and FBS are all used regularly and, except on high-risk deliveries, the clinic has no guidelines on when each of the methods should or need to be used. Again, according to the chief of medicine, freedom is very important and guidelines should not control everything. (Interview 17)

STAN does not has any impact on the distribution of responsibilities between midwifes and doctors, at Linköping University Hospital. The personnel work in teams where the team members have mutual responsibility. Both doctors and midwifes are involved during the whole delivery, which means that there is no case when the midwife can wait to consult the doctor when using STAN. (Interview 17)

Concerning the clinical benefits for the patient, the trust in the method is high. Linköping University Hospital has not actively measured any effects but believe the method reduce both the need for FBS and risk of metabolic acidosis. In addition, the clinic has experienced a reduction in the number of caesarean sections from 20 percent to 10 percent, which is considered partly due to STAN. STAN forces the personnel to improve its knowledge and skills in fetal monitoring in general. The method is perceived as providing a highly helpful decision basis. (Interview 17)

According to the chief of medicine, there exist a general traction towards "normal" deliveries within the field of maternity care in Sweden. However, at the clinic at Linköping University Hospital this group is relatively small. Today there exist two groups at the clinic; around 90 percent of the personnel are positive to new technology while around 10 percent are more conservative. Linköping University Hospital has the ambition that as many deliveries as possible should be vaginal, if that goal is reach by technology or not does not matter and is high individual to the patient and the midwife. (Interview 17)

Decision to Introduce STAN

The official decision to implement STAN was made around 2000-2001 by the head of the department. At that time, there was a wish and need within the field of fetal monitoring to predict metabolic acidosis. Everyone knew the existing method previous to STAN was insufficient in this

matter and some believed that STAN could be the solution. Therefore, Linköping University Hospital decided to start using the method. (Interview 17)

Implementation

The clinic purchased two STAN-devices and initially sent one doctor and four midwifes to training in Norrköping. Later a doctor at Linköping University Hospital held the training for the rest of the personnel. (Interview 18)

There definitely existed resistance towards the method in the beginning at Linköping University Hospital. Some personnel had heard or obtained negative experiences of STAN from a neighboring hospital in Mottala, where the STAN method had not been used properly. In addition, there existed several controversial cases from other hospitals when the use of STAN had resulted in ill-fated outcomes. To prevent the resistance and establish a better understanding of the STAN-method at the clinic, the personnel were involved in jointly discussions and investigations of the controversial cases. As the cases were discussed in detail, the personnel got a clear picture of what had really happened and concluded that the ill-fated outcomes was not due to the technology in itself but to non-properly usage of STAN. (Interview 18)

The clinic in Linköping University Hospital managed to get support from the personnel regarding the method, the implementation was successful and Linköping University Hospital increased the number of STAN-devices from two to 7 within one year. (Interview 18)

Linköping University Hospital identifies two major key success factors in their work of implementing STAN at the clinic: driving spirits and continuous trainings. The clinic has established a well-functioning working process that is based on having a coordinator that is responsible during every working period. The coordinator has an overall insight in all deliveries and act as support and a coach to its colleagues. Due to the presence of the coordinator less experienced personnel can feel more confident and secure in their work and in using methods such as STAN. In fact, the coordinators are often carefully chosen to be individuals that can influence and help its colleagues to increase their usage of methods such as STAN. During every working period, it is also ensured that someone highly experienced in CTG as well as STAN is available to answer possible questions. The collaboration between the personnel has always been good and the clinic has an open climate where everyone can ask everyone for help. That encourages less experienced personnel to try out and start using new methods such as STAN, because there is always someone to help. In the beginning, when the STAN-method was new at the clinic and only few people were experienced in the method, the personnel could call home to their more experienced colleagues to ask for advice even if the experienced persons were not working. (Interview 17 and 18)

The freedom to individually choose method in the daily work, in combination with the support and encouragement from coordinators in new methods, increases the motivation and willingness among the personnel to learn and develop in their profession. Further, the continuous discussion of real cases at meetings with the personnel has also been a factor to success. Development of knowledge is critical for active use of the STAN-method. (Interview 17)

The Role of Neoventa

Linköping University Hospital perceives they have received insufficient support and help from Neoventa over the years and when implementing STAN. The educational material given was not to

enough and additional help was not given. Linköping University Hospital has been doing all the training by themselves. Due to the clinics high interest in the method, Linköping University Hospital would have expected more attention from Neoventa. (Interview 17 and 18)

The clinic still think the attention from Neoventa is low, one example is the webb-training which had have the same questions in 8 years despite repeated expressed need for changes. In addition, Linköping University Hospital thinks it is a big mistake by Neoventa to price the webb training extremely high. With such an expensive training, it is not difficult to see why clinics lose their competence in the method and eventually place them in the basement. (Interview 17 and 18)

7.2.4 Mölndal Hospital - Sahlgrenska University Hospital in Sweden

Mölndal Hospital can be considered a reference clinic for the STAN-method. The clinic has 8 devices, one device in each delivery room, and uses STAN on all deliveries, unless the mother has any other personal requests. Fetal monitoring is considered highly important and the policy at the clinic is to always use all available resources during the whole delivery. There exist no such thing as "some" monitoring. A maternity care unit should be seen as an intensive care unit; a delivery is one of the most hazardous moments in life and all resources should be used to make it safer. According to the head of clinic, Mölndal Hospital is worldwide the most experienced clinic on using STAN and is also leading the development of the method. (Interview 22)

The focus on fetal monitoring is very high and all personnel are regularly trained. In addition, the clinic is constantly analyzing and discussing cases related to STAN and fetal monitoring to maintain and improve the knowledge. The method is perceived as a great support during deliveries and the personnel have increased their knowledge on the physiology on the baby. (Interview 22)

The clinic has experienced significant benefits from the method in terms of reduced operative interventions such as caesarean sections and obstetrical vacuum extraction suction cup and metabolic acidosis. In fact, the clinics results show in principle no cases of metabolic acidosis. The chief of medicine, believe Mölndal Hospital's great results is due to their commitment to the method. If a clinic does not commit and use the method to its fully extent, they will not see any significant results. (Interview 22)

Mölndal Hospital does not consider itself as a neither innovative nor conservative. (Interview 22)

Decision to Introduce STAN

The decision to implement STAN was driven by the current chief of medicine at the clinic. At the time of the decision, the chief of medicine was doing his doctoral dissertation on, in fact, the STAN method with the STAN-method's innovator as supervisor. The chief of medicine was convinced about the benefits of the method and highly determined to implement STAN. (Interview 22)

At Mölndal Hospital there was a concern regarding the high costs of maternity care, both economically and in terms of side effects for women who were paying with their bodies. The high costs were mainly due to the large number of unnecessary operative interventions. Therefore, Mölndal Hospital saw a great need to reduce those operative interventions. (Interview 22)

Implementation

Mölndal Hospital initially purchased about 4 devices, which was a relative large number. At the same time, the clinic invested substantial resources in training all personnel; the training was held by

Neoventa and the method's innovator. In addition, two midwifes, who were specialized on STAN, worked full time on establishing the method in the daily work at the clinic (Interview 22). Initially STAN was used only on high-risk deliveries, but shortly the clinic realized that the method had to be used more often in order for all personnel to learn how to use it. Thus, the clinic started to use the method on all deliveries. The aim was to establish the method as part of the daily work, similarly to "brushing the teeth". This was to reduce the risk of not knowing how to use it when real critical cases appeared. The number of devices was soon doubled to today's 8 devices. (Interview 22)

The clinic has always been stringent in using the guidelines provided by Neoventa in the daily work. However, as Mölndal Hospital is the worldwide leader in the method and its development, suggestions on changes of the guidelines have often been discussed and investigated (Interview 22). As a part of Sahlgrenska University Hospital, the clinic at Mölndal Hospital has always competed with the larger maternity care unit at Östra Hospital. The fact that the maternity unit at Mölndal Hospital is the smaller clinic has motivated them to show they are better, for example by lowering their number of babies with metabolic acidosis. This motivation has helped in driving the usage of STAN. (Interview 22)

According to the chief of medicine, three key success factors for implementing STAN at Mölndal Hospital was (a) commitment from an opinion leader (the chief of medicine), (B) the large investment in training of personnel and (c) the fact that the clinic was relatively small and had great unity (Interview 22). The implementation of STAN at the clinic at Mölndal Hospital did not meet any significant resistance. However, as there exists a natural negative attitude towards technology in health care, it is important to clearly convince the personnel about the benefits of the technology. Generally older obstetricians and midwifes are more negative to new technology than younger, since they are blocked by their old knowledge. (Interview 22)

The Role of Neoventa

When introducing STAN, Neoventa was responsible for all training of the personnel. Today, the clinic is managing the training by themselves but Neoventa is still contributing to the work by for example inviting midwifes from different hospitals to meetings in order to discuss and exchange experiences on STAN. In addition, in June 2013 Neoventa is enabling a specialist from St George's Hospital in London to visit Mölndal Hospital and hold a CTG master class. The purpose is to even further improve the knowledge and perspective on STAN by discussing how STAN is used at hospitals outside Sweden. (Interview 22)

7.2.5 St George's Healthcare NHS Trust in London, UK

St George's Hospital started using STAN in 2002, at the time there were three units installed. Prior to this, one obstetrician was involved in the very first research on the method. Early on, STAN was used only on risk patients such as those arriving with prior infections. The rationale for this was the limited availability of STAN units, meaning that some form of patient selection on who should be monitored with the equipment was required. In retrospect, the Lead of Clinical Governance in Obstetrics and Gynecology at St George's Hospital believes that this was a mistake. Few devices together with training only a small number of obstetricians and midwives meant that use of STAN was very irregular. Only those that were very comfortable with the technology used it. In the case of on call personnel for example, not many were comfortable to the use of STAN was very low. When the first 1002 cases of STAN use were published in a medical journal, 14 abnormal cases were present. As a

result of irregular use and large variance in personnel comfort with STAN, almost all of these 14 cases had elements of human error in them. (Interview 23)

Responding to the apparent lack of consistency in the use of STAN, St George's Hospital changed their goal on using STAN. Firstly, all relevant personnel were trained in the method as opposed to only a few selected ones. This was done in order to increase the general comfort with the method, and led to increased use of STAN on applicable patients. Secondly, it was thought that more devices were needed in order to signal that the hospital was serious about applying this method in fetal monitoring. Therefore, 14 new units were purchased which corresponds to one unit per room. Finally, the policy of STAN usage was changed. At this point in time, it was decided that all patients that went on electronic fetal heart rate monitoring, or CTG, would also automatically be placed on STAN monitoring if not contra-indications such as HIV are present. (Interview 23)

The STAN-method is perceives by St George's Hospital as a method with many advantages. According to the Lead of Clinical Governance in Obstetrics and Gynecology, use of the method has contributed heavily to important improvements in clinical outcomes. Specifically, the hospital has, at 6.1 percent, the lowest percent of unnecessary interventions in the United Kingdom. Furthermore, the hospital also has the lowest percentage of emergency caesarian sections as well as babies born with brain damage. The main disadvantage with the method is perceived to be the potential of failure in training. St George's has experienced that if a person that is inadequately trained in using CTG attempts to use STAN, that person will not use STAN correctly. This was, together with misuse of established usage guidelines, considered to be the main problem at St George's at the time when STAN was first introduced. The introduction of the STAN-method at St George's led to a redistribution of responsibilities between obstetricians and midwives. Before the introduction, monitoring with CTG was mainly led by obstetricians. The way that training is conducted has placed a much more equal distribution of responsibilities across the two categories of clinical professionals. Many, many midwives are now trained very well in fetal monitoring and fetal physiology, which empowers them to take more responsibility. In fact, the person that is responsible for all certification at St George's, which is mandatory for both categories of clinical professionals, is a midwife. As a result of the above, the STAN-method is considered to provide good support for obstetricians and midwives in their daily decision-making and care provision. (Interview 23)

St George's Hospital places an emphasis on people rather than technology. While any medical technology is associated with benefits and costs, its ultimate usefulness is determined by the people that wield the technology in clinical practice. The Lead of Clinical Governance in Obstetrics and Gynecology in fact exemplifies that even the best technology may cause problems if inappropriately used. St George's is currently part of a large European investigation into the usefulness of new technologies in terms of clinical outcomes. Most of the time when a failure somehow related to technology occurs at St George's, it is a question of not having reached an understanding on how to apply technology as well as when not to apply it. (Interview 23)

Decision to Adopt

The decision to adopt STAN in 2002 at St George's was taken with the background that CTG was known to have a rate of false positives, meaning babies in distress which are missed, of over 60 percent. This was a widely agreed situation in the UK at the time, and the default position among hospitals was therefore to use FBS as the main method of fetal monitoring. However, this method

only detects what is called peripheral acidosis through a scalp blood sample. It was thought beneficial to base decisions on the central organs instead, due to possibilities of more accurate knowledge of the baby's condition. STAN was the only method that offered this possibility through directly monitoring oxygenation on the heart, hence the decision to adopt it. (Interview 23)

Implementation

Achieving an enthusiastic buy-in from midwives was considered the first and most important goal of the STAN implementation at St George's Hospital. The assumption was that if one does not know much about STAN, one will resist it. After improving the knowledge of all involved personnel through extensive training, resistance was significantly reduced. In fact, STAN training was taken very seriously throughout the later implementation phase when more devices were brought in and all personnel were subjected to the training. Every Monday contained a full day's training on both CTG and STAN. Furthermore, there was one additional opportunity per week of a half-day training session. Importantly, this training incorporated mandatory elements. For instance, every obstetrician and midwife has to, and must still today, attend one every month or six every six months. This resulted in employees being convinced of the usefulness of the method, through understanding the technology behind it, as well as the seriousness of St George's commitment to it. People were perceived to feel comfortable with STAN at this point in time. (Interview 23)

Another important aspect of implementation was the continuous presence of a person working full-time with teaching how to use the STAN-method. Initially, this person was a midwife provided by Neoventa. When this person left, St George's hospital continued with an internally recruited replacement. The aim of this position was mainly to support obstetricians and midwives in STAN-related areas. It was believed that people working full time with STAN-training was critical for a successful implementation. A new way of ensuring quality was also practiced in relation to the STAN implementation, namely extensive testing. As described above, testing was an important aspect for clinical professionals working with STAN at St George's Hospital. This approach was radical in the sense that the hospital was the only one in the UK at the time that implemented a test certification for fetal monitoring methods. (Interview 23)

The implementation of STAN met some resistance among staff initially. This was especially noticed in relation to the newly-conceived test certification policy. Employees simply did not look kindly upon having to take a test before being allowed to practice their profession in fetal monitoring. However, the hospital's leadership made it clear that quality was critical and the test a part of their quality assurance strategy. It took almost 18 months for the Lead of Clinical Governance in Obstetrics and Gynecology to achieve an initial acceptance for the testing procedure. It was not until 2009 that this became fully accepted and an automatic part of the hospital policy. (Interview 23)

One final aspect of importance in the implementation was the use of clinical guidelines for STAN. At St George's Hospital, new labor ward guidelines were introduced at the same time as the STAN-method. It is believed that these have been very helpful in overcoming resistance among clinical professionals in the sense that it provides more structure in how to apply the method, thereby reducing uncertainty. In fact, the Lead of Clinical Governance in Obstetrics and Gynecology has also published research on appropriate guidelines for clinical use of the STAN-method. These revolve around not simply reacting to events generated by the STAN-unit, but proactively classify the CTG curve and correlate STAN-events in relation to the CTG curve. (Interview 23)

Neoventa's Role

Neoventa supported the adoption and implementation of STAN at St George's by localizing one of their employees, a midwife and expert in the STAN-method, at the hospital full-time. Furthermore, continuous support was provided directly from the headquarters in Sweden as well as via the local agent and distributor in the United Kingdom. St George's were satisfied with the support throughout the process. (Interview 23)

7.2.6 Halland County Hospital in Halmstad, Sweden

Halmstad Hospital employs the STAN-method on all births, automatically activating the method as soon as the baby is put on electronic fetal monitoring. The hospital has seven STAN-units, or one per room, as well as a mobile STAN device in reserve. The objective of having one device per room is to make it mandatory to use the method when monitoring. The chief physician of obstetric care at Halmstad Hospital describes that the hospital believes that if less STAN units were in place, one would have to choose which patients to monitor with STAN based on risk, which is viewed as negative in Halmstad. The hospital in Halmstad were among the fast followers in adopting STAN, meaning that it adopted the method a short time after the first hospitals that were using it in research purposes. (Interview 25)

The chief physician states that the leadership of obstetric care in Halmstad believes that there is no single method that can be viewed as the golden standard in fetal monitoring. Rather, all available methods have weaknesses. When it comes to the STAN-method, the main advantage is that it is very good in complementing other information sources, it increases security since it forces clinical professionals to be disciplined in administration of care and there are scientific studies showing a number of clinical benefits from using the method. On the negative side, the STAN-method must be used correctly which is not always trivial. The dominating view in Halmstad is that the STAN-method requires a significant amount of knowledge form the user in order to be correctly applied. This level of knowledge further takes time to develop, which is also a drawback. In relation to the need for training and knowledge, the chief physician believes that it is easier at a mid-sized unit such as the one in Halmstad compared to larger units in larger hospitals and cities. One advantage with training people at a hospital such as Halmstad is that personnel tend to stay in their positions longer. In other words, the personnel turnover is lower, facilitating training and knowledge-raising efforts. It is believed that starting from scratch with the STAN-method at a large hospital is very demanding in terms of training effort. (Interview 25)

The STAN-method is not perceived to have changed any formal relationship between obstetricians and midwives, since they were already supposed to be working as a team. However, it is likely that that some responsibility has de facto been shifted in the direction of the midwives. This professional category has increased their knowledge since the method was adopted and now receives more information. Therefore, they can participate more in discussions with obstetricians as to which actions are appropriate to take. Regarding clinical benefits, the leadership of Halmstad Hospital are convinces that the STAN-method has resulted in significant improvement. Furthermore, STAN is in almost all cases perceived as increasing the level of decision-support available to clinical professionals. Only in a very small part of all cases does the method perform less than one hundred percent in terms of decision-support. If this happens, it is usually a result of the extra information causing the user to doubt his or her actions. (Interview 25)

Halmstad Hospital considers itself as innovative in relation to fetal monitoring but also in relation to technology in general. The hospital has been early in adopting many new technologies, methods and equipment. Many representatives from other hospitals visit Halmstad in order to investigate how new technology or equipment is used. The overall philosophy on fetal monitoring is to keep it natural as much as possible, but with security as the main aspect of interest. Therefore, many cases warrant the use of electronic fetal monitoring with CTG and STAN. Halmstad views themselves as supporters of the school that advocates monitoring, but only when it is necessary. The most important aspect is to ensure safety and a good outcome of labor, which may mean that some unnecessary surveillance is conducted. (Interview 25)

Decision to adopt

The decision to adopt STAN was mainly done in order to follow the lead of the hospitals that initially participated in research on STAN. At the time, the method was communicated country-wide as the ultimate solution within fetal monitoring. Therefore, the main reason for the adoption was clinical benefits, as they were described at the time. The decision to adopt was strongly driven by the chief of medicine at Halmstad Hospital. However, a lot of things changed quickly. Perhaps most important were the accusations of misconduct on behalf of the early STAN-researchers, but there was also a lot of prestige and emotion involved between key people in these events. The chief physician at Halmstad Hospital believes that too much trust was placed on the STAN-method at the time of initial adoption, which meant that not enough rigor and discipline were employed in fetal monitoring with CTG and STAN in combination. The response to these events from Halmstad Hospital was to change the way in which STAN was used, not to abandon the method. There was still belief in the merits of STAN. Concretely, the guidelines for use were changed, enforcing more rigor and discipline. (Interview 25)

The initial decision to adopt STAN meant that two units were purchased. These units were in the beginning mobile, which meant that there had to be selections on which patients that were to be subjected to STAN-monitoring. As previously purchased CTG units quickly became old, more STAN units were bought as replacements. The reason for changing all old CTG units to STAN-units and have one STAN per room was that the hospital was very satisfied with the method. Due to this, the leadership thought that the best course of action as to be consistent and use the method that they viewed as the best as much as possible. This would enable all personnel to feel comfortable and ensure a consistently high level of knowledge at the clinic. It was felt that both old and new personnel would learn the method most rapidly if it was used extensively. As more STAN-devices were installed, the area of application was increased from risk patients only to all patients. (Interview 25)

Implementation

The implementation of STAN at Halmstad Hospital was done with a large focus on training midwives and obstetricians. Initially, two obstetricians and five midwives were trained, which was considered a large training effort. Additionally, parallel training was done with the objective to improve knowledge in the base method CTG. In fact, one of the big gains from the implementation process, except increased STAN-knowledge, was a more systematic knowledge about how to conduct electronic fetal monitoring with CTG. In turn, these initially educated professionals could themselves educate their colleagues. It has been shown that the level of CTG- and STAN-knowledge is very high at Halmstad Hospital as a result of these actions. Other than regular training, Halmstad Hospital also implemented

a reference group of midwives who are very skilled in CTG and in STAN. These individuals spread new knowledge to their colleagues and monitor externally in order for the hospital to stay updated. They also act as reference point for colleagues when support is needed, both for obstetricians and for midwives. Staying updated is viewed by the leadership in obstetric care as very important. (Interview 25)

An important part of STAN-implementation was also to implement guidelines for how the method was to be applied in clinical practice. Here, Halmstad Hospital strictly followed nationally set guidelines, which is something that is still done today. However, implementation of the STAN-method was not completely smooth. The amount of work required in order to implement the method was viewed as relatively high, even if no major problems were encountered. The new overall mindset on fetal monitoring; to use the STAN-method on all patients met some resistance and also some individuals were reluctant to learn STAN. The method was perceived by a significant part of professionals as complex and difficult to interpret. Users frequently thought that the STAN-method was non-trivial to use in general. Especially the very disciplined CTG-interpretation aspect of using STAN was thought to be difficult. The technology itself was not considered to be a problem to use among clinical professionals at Halmstad Hospital. (Interview 25)

Another aspect of resistance was the fact that there is not always a clear-cut relation between information from the STAN-unit and the baby's actual health. Occasionally, users are still surprised by the outcome after having used STAN during labor. This fueled some of the experienced resistance. The opinion of the leadership in obstetric care was that this was an inherent limitation of the method itself and not something that affected whether it should be used or not. In fact, the chief physician attributes this to the more general situation where no method is perfect today. However, this required significant pedagogic effort from leadership at the clinic. A final aspect of resistance was resistance to technology from midwives. This category of professionals generally believe that births should be natural and that one should not take too much unnecessary action or connect too much monitoring equipment as this disturbs the natural process of birth. There are in fact a few scientific studies that corroborate this view. However, this resistance was too small to be viewed as a problem. (Interview 25)

The role of Neoventa

Neoventa's main role was as provider of the STAN-units and provider of support and education. Halmstad Hospital perceives that the level of support has been good historically since they adopted STAN. Support has been given both on a technical as well as on an educational level. Training provided by the company has been used to a benefit by Halmstad Hospital, and the chief physician believes that this relationship will continue in the future. Training sessions in CTG and in STAN are critical for maintaining a high knowledge level and Neoventa is perceived as a good provider of such education. (Interview 25)

8. Analysis

This chapter presents the analysis of the empirical findings from the pilot- and continuation study in relation to the theoretical framework detailed in chapter 5. The purpose of this chapter is to answer the main research question "What are the differences between successful and unsuccessful cases in terms of adoption of the STAN-method, and what can be learned from these differences, in order to overcome barriers to adoption and diffusion of the STAN-method at hospitals in general?" The chapter is divided in two parts, first successful and unsuccessful cases will be analyzed in relation to the Diffusion Framework. Second, Neoventa's sales model will be analyzed in relation to the Technology Marketing Model as well as the insights from the first analysis.

8.1 Analysis of Diffusion Dynamics

In this section the Diffusion Framework presented in section 5.1 is used to analyze the differences between successful and unsuccessful cases from both the pilot and the continuation study. Thus, this analysis covers the first part of the main research question. In the analysis, successful cases will refer to Ryhov, Oslo University Hospital, Linköping University Hospital, Mölndal Hospital, St Georges and Halmstad Hospital, while unsuccessful cases will refer to NÄL, SLL and Skåne University Hospital in Malmö and Lund. This analysis will further relate back to the insights from the pilot study; the five parameters will be connected to relevant factors in the Diffusion Framework. Hence, the parameters will be analyzed in terms of the diffusion framework.

8.1.1 Technological Factors

A comparison of successful and unsuccessful cases reveals two technological factors that are not critical in relation to adoption and diffusion of the STAN-method, namely risk and reinvention. Beginning with risk, there was no manifestation of any direct threat to the power base of the hospitals from adopting the STAN-method. Obstetricians can be viewed as the power base since decision-making authority rests with this group of professionals. The STAN-method provides more information to midwives, the subordinated professional category. It is therefore conceivable that an introduction of the STAN-method implies a shift of power in favor of midwives, an opinion that was put forward by the hospitals SLL, Ryhov, Halmstad Hospital and St George's. St George's perceived the clearest change in responsibilities, stating that midwives clearly gained significant responsibility with the STAN-method in place. However, Ryhov, NÄL, Skåne University Hospital, Linköping University Hospital, Mölndal Hospital and Halmstad Hospital all agreed upon the fact that the responsibility structure is left largely intact. In fact, Oslo University Hospital and Linköping University Hospital stated that the STAN-method helps both categories of professionals work together. Cooperation between the two categories was also emphasized by St George's in explaining the effect of their significant shift in responsibilities. This leads to an understanding that personal risk to the power base is not a critical factor to consider, since no studied hospital with experience of the STAN-method perceived any such problems. In contrary, the opposite holds in several instances where team-work benefits were perceived. The other factor, reinvention, is also of low significance for similar reasons. No studied hospital with STAN-experience stated that there was any need to adapt the technology to the organization's or personnel's specific needs. Further, interviews with medical technological engineers at Ryhov, NÄL and Skåne University Hospital revealed that the product-organization fit was good and that no issues were present.

The factor relative advantage is however of clear importance. Perceived relative advantage differs extensively between studied successful and unsuccessful cases. Comparing success cases, Ryhov

perceive large benefits such as decision-making support and increased knowledge gained from being educated in and using the method. Mölndal Hospital, taking a more medical approach, emphasizes large benefits in terms of clinical outcome from using the STAN-method. Further, St George's perceive benefits both regarding clinical outcome, emphasizing their leading position in the UK, as well as a positive effect in decision support resulting from better team-work. Halmstad Hospital in turn emphasizes clinical benefits as well as decision support, the latter arising mainly from increased discipline in monitoring interpretation. Finally, Oslo University Hospital and Linköping University Hospital take a holistic approach and emphasize benefits in team-work across professional categories, clinical benefits and decision support in their assessment of relative advantage. It is therefore clear that, while the exact advantage differs, all success cases see significant relative advantage from using the STAN-method in one or in several of the areas: clinical outcome, team-work and decision-support. Comparing with unsuccessful cases, a very different picture of perceived benefits can be discerned. NÄL state that the STAN-method is equivocal; emphasizing that no clear benefits have been seen in any of the three areas mentioned above and that there is a divided staff across both professional categories with considerable uncertainty associated with the method. At Skåne University Hospital, relative advantage was directly considered non-existent. In fact, interviewees from this hospital stated that they did not see any improvement whatsoever in using the STAN-method compared to using only CTG, which they considered themselves to be very good at. The situation is similar at SLL, where a formal HTA has been important in influencing regional hospitals' perception on the STAN-method's benefits as being outweighed by its drawbacks. Clearly, relative advantage is seen as very low or non-existent in unsuccessful cases. In the pilot study, the parameter "clinical benefit to the patient" was identified as one of the barriers to adoption and diffusion of the STAN-method. It can now be understood that success cases have overcome this barrier and are convinced that the STAN-method holds a relative advantage in comparison to other methods, specifically in clinical benefits, team-work and decision support. This belief is absent in unsuccessful cases.

Also related to the barrier "clinical benefits to the patient" are the two technological factors observability and trialability of the STAN technology. Trialability, the degree to which the STAN-method can be tried on a limited basis prior to adoption, is low as a direct consequence of the differences in perceived relative advantage. All unsuccessful hospitals used STAN to a limited extent only; NÄL intermittently on risk patients and Skåne University Hospital during a short time period only. As presented above in connection to relative advantage, these hospitals did not perceive an adequate level of benefits from the method. Success cases investigated, on the other hand, all used STAN more extensively; Ryhov, Mölndal Hospital, Halmstad Hospital and St George's on all deliveries, Oslo University Hospital on a large volume of nationally sourced risk patients and Linköping University Hospital on risk- and optionally also on non-risk patients. These hospitals all have in common that they perceive large benefits from STAN. Hence, it can be argued that trialability in the form of a limited-use test of STAN is low, since benefits are only perceived at hospitals that use the method on a larger scale. Inability to conduct a trial and experience the benefits of the STAN-method before a larger-scale adoption therefore contributes to the barrier "clinical benefits to the patient". Observability, being a measure of visibility of benefits to others, can be considered lowered by the fact that there are many cases of hospitals that use STAN on a limited basis, in this thesis represented by the unsuccessful cases of NÄL and Skåne University Hospital. Such instances where the STAN-method has been adopted and used only on a limited basis such as certain risk patients, limits the

observability of benefits to other potential adopters. These adopters are faced with an unclear picture of whether the method is associated with benefits or not, contributing to the barrier “clinical benefits to the patient”.

Compatibility, referring to the fit between the method as an innovation and the processes or working tasks that it will be introduced into, is clearly an important technological factor. Required investments, mainly in the form of STAN-training but also in routine changes, are perceived as high by Ryhov, Mölndal, Halmstad Hospital and St George’s. Furthermore, NÄL, Skåne University Hospital and Oslo University Hospital perceive that the added requirement of also improving base CTG knowledge is burdening for an adopting hospital. In fact, SLL perceive these investments into training and changed routines as so high that a future adoption becomes problematic. It can therefore be understood that compatibility of the STAN-method with a hospital that uses CTG or other fetal monitoring methods is low. Low compatibility manifests itself in the pilot study barrier parameter “training and knowledge”. In fact, low compatibility between existing practices and those dictated by the STAN-method can be understood as causing the barrier.

Complexity has a similar relationship to this parameter. However, there is here a difference between success cases and unsuccessful cases. In unsuccessful cases, the complexity of STAN is perceived to lead to uncertainty among its users and problems in applying the method clinically. At NÄL, midwives perceive that the uncertainty leads to a frequent need to call for assistance as well as stress related to questionable reliability of the method in clinical use, even if the method does provide more information on the baby. Skåne University Hospital is similarly divided on whether STAN produces a truer but more complex picture or simply more contradicting information. Looking at success cases, Ryhov and St George’s perceive that complexity is high but can be reduced by adequate training. Oslo University Hospital, Mölndal Hospital, Halmstad Hospital and Linköping University Hospital further perceive that complexity is something that has to be accepted, and dealt with through training, in light of the significant benefits of the method. From this picture of perceived complexity, one understands that hospitals that have successfully adopted the STAN method have, unlike their opposite counterparts who perceive complexity as very negative, accepted this as a necessary drawback and perceive that it can be mitigated to a satisfactory level with training. Therefore, it can be understood that high complexity is also a cause for the manifested barrier parameter “training and knowledge”.

In close connection and with a more direct effect on the barrier “training and knowledge”, are the technological factors knowledge required for use and augmentation/support. Clearly, the STAN-method requires knowledge to use. In fact, using it correctly and beneficially is perceived by the success cases Ryhov, Mölndal Hospital, Linköping University Hospital, Halmstad Hospital and St George’s as requiring significant knowledge, thereby indicating that it is not easily codified and transferred. Therefore, this factor can be argued to further contribute to causing the adoption and diffusion-barrier “training and knowledge”. Regarding augmentation/support, that is the inclusion of for example training and support with the product, all hospitals investigated stated that the STAN-method cannot be adopted on its own but requires both these things as augmentations. A particularly clear example is Linköping University Hospital, which expressed discontent with the level of support received after showing a large interest in STAN. The respondent related this situation with low support as one which could easily have caused a decision to abandon the method entirely. In fact, both the previously discussed knowledge required for use as well as necessary augmentation in

the form of training and support can be understood as contributing to the barrier "training and knowledge".

Moreover, perception on task issues, whether the technology is relevant to the users' tasks and task performance, varies between success cases and unsuccessful cases. In all success cases, the technology is considered highly relevant. Ryhov, Halmstad Hospital and Oslo University Hospital perceive that STAN helps support decision-making for both professional categories through provision of more information. Mölndal Hospital considers the method to be a great support for their clinical professionals. Both St George's and Linköping University Hospital perceive that the method is closely connected to performance in key measurements of the healthcare unit's delivered quality. In contrast, unsuccessful cases do not view it as relevant to the same extent. At NÄL, a significant part of professionals do not view the method as supporting their decision-making. At Skåne University Hospital, the situation is similar with a view of STAN as being partly dangerous to rely too much upon for decision-making. It can be understood from this that successful cases, unlike their unsuccessful counterparts, are convinced of the fact that STAN is valuable in decision-making and relevant for task performance. Unsuccessful cases can be understood as cases where professionals perceive STAN to be less relevant in this aspect. Task issues therefore contribute to causing the identified barrier "decision-making support".

To summarize, the technological factors risk and reinvention can be considered less important in relation to adoption and diffusion of the STAN-method. Whereas Relative advantage, Compatibility, Complexity, Trialability, Observability, Task Issues, Knowledge required for use and Augmentation/support were all found to be crucial. Together, those factors illustrate that the STAN-method itself has characteristics that in many aspects makes it a challenging technology to spread.

8.1.2 Organizational Factors

Several organizational factors can be concluded to be less relevant to adoption and diffusion of the STAN-method. Teaching status, in which teaching hospitals are seen as more likely adopters, is less relevant since this study has found non-teaching hospitals as enthusiastic to STAN and teaching hospitals rejecting it. For example, SLL includes a well-reputed teaching hospital, Karolinska, and rejects STAN. At the same time, Ryhov is a non-teaching hospital and is very enthusiastic to the method. Reputation and Prestige is another factor that can be argued to be less relevant. In fact, this study has found very prestigious hospitals that are rejecting the method, such as Karolinska in SLL, and less known ones that are very enthusiastic about STAN, such as Ryhov. Since teaching status and reputation and prestige are less relevant, the same holds for the correlated factor hospital age. The factor size is less relevant for similar reasons. In fact, this study has found smaller hospitals that are enthusiastic to STAN, such as Ryhov, and small hospitals that are uncertain as to its benefits, such as NÄL. Further, large hospitals in the study were either enthusiastic, such as St George's, or rejecting the method, such as hospitals in SLL. Hence, size can be understood as less relevant.

Regarding external integration, all hospitals investigated were clearly aware of the STAN-method as a new development. There was no difference between hospitals regarding the degree of focus on communication and external connections; all focused to a high degree on maintaining such integration with the external environment. Therefore, the factor external integration can be understood to be less relevant to adoption and diffusion of the STAN-method. Finally, organizational resources is also a factor of less relevance. This can be understood from the fact that high allocation

of resources to adopt the method, such as initially at Skåne University Hospital, is not enough for success. This can also be understood from the fact that purchasing decisions at hospitals in this study were largely based upon perceived benefits rather than cost. For example, Ryhov and NÄL both state that the cost is of less importance in comparison with the benefits. In other words, an organization with more resources is not necessarily one that is more inclined to adopt STAN, and the factor organizational resources is therefore of less relevance.

Moreover, two organizational factors were not possible to evaluate from findings in this study. Firstly, not enough information was generated regarding the centralization of respective hospital, which means that it is not possible to distinguish the importance of the factor centralization for adoption and diffusion of the STAN-method. Secondly and in similar fashion, the functional differentiation of each hospital was not clearly enough determined in findings to enable any insights into the effect of this factor.

A receptive context for change is however an important organizational factor for adoption and diffusion of the STAN-method. A receptive context for change includes strong leadership, clear goals as well as acceptance of risk and experimentation (Greenhalgh et al., 2004). Such a context was not present in unsuccessful cases. At NÄL, leadership in the specific area of fetal monitoring technology was weak with unclear goals. This can be discerned from the fact that STAN was initially purchased with a goal to be used extensively but later, these goals changed. The number of STAN devices was lowered and training decreased. The leaders included in the interview themselves express that the current situation was not desirable. Furthermore NÄL expressed a low risk- and experimentation tolerance, which can be discerned from the anxiety that was displayed towards problems that may arose from using technology too much at the maternity unit.

At Skåne University Hospital, STAN-units were randomly distributed between rooms even if the initial aim was to use the method on all deliveries. This indicates that the hospital lacked strong leadership and clear goals on the usage of STAN. Furthermore, it was explicitly stated that one reason for why STAN was not used was that no person did take the initiative, a testimony for the lack of strong leadership. The fact that midwives frequently chose methods of fetal monitoring regardless of the opinion of obstetricians is further a testimony to the lack of clear goals. Regarding acceptance of risk and experimentation, Skåne University Hospital can be concluded to be conservative in this aspect. This can be discerned from the overnight removal of the STAN-method following the accusation of misconduct related to the Swedish RCT researchers. At SLL, complete disinterest in the method can be viewed as a lack of all three components of a receptive context for change.

At success cases investigated, the situation is however very different. Ryhov, Möndal, St George's, Oslo University Hospital, Halmstad Hospital and Linköping University hospital all had strong leadership where one high-ranking person that provided direction. Furthermore, in these cases this person set clear goals on how to use STAN. Even in the success case of Linköping University Hospital, where the STAN method was viewed only as an option for clinical professionals to choose and not associated with forceful guidelines, the goals of STAN-use were clear. Also, all success cases were found to have an open attitude to risk and experimentation in comparison to unsuccessful cases. The clearest examples are Ryhov and Halmstad Hopsital, two hospitals that explicitly seek to be innovative and try new medical technology. Oslo University Hospital, St George's, Mölndal Hospital, Halmstad Hospital and Linköping University Hospital all exhibited an open attitude to the method at

the time of its introduction. From this, it can be understood that success cases display a more receptive context for change in terms of strong leadership, clear goals and a high enough willingness to experiment and take risk when introducing new medical technology.

Related to having a receptive context for change is the organizational factor absorptive capacity for new knowledge. This factor details the organization's ability to find, understand, adapt and incorporate new knowledge(Greenhalgh et al., 2004). Among unsuccessful cases, knowledge of the STAN-method was not absorbed to the same degree as in successful cases. The clearest example is NÄL, where considerable uncertainty related to the use of STAN lingered regardless of the time passed since its first introduction at the hospital. However, also Skåne University Hospital displayed less knowledge absorption when stating that the use of the STAN-method was incorrect at the time when it was implemented at the hospital. Finally, SLL exhibited a NIH-syndrome, which is a strong case of inability to absorb knowledge that originates from outside the organization or, in this case, the region. The success cases Ryhov, Oslo University Hospital, Linköping University Hospital, Mölndal Hospital, Halmstad Hospital and St George's all exhibited a high level of knowledge absorption, most strongly attributing this to their consistent focus on training over time since their respective STAN-introduction. The two organizational factors receptive context for change and absorptive capacity for knowledge can from the above be understood to cause the adoption and diffusion barrier "attitude towards technology", since it describes unwillingness to take risk as well as inability to absorb knowledge it terms of making use of technology to gain benefits. Furthermore, these two organizational factors also contribute to the barrier "philosophy on obstetric care". This can be understood since the philosophy to have natural births involves both a reluctance to employ technology, which required absorption of knowledge, as well as reluctance to change the way in which work is done, which depends upon the receptiveness of the context towards change.

To summarize, the two non-structural factors Receptive context for change and Absorptive capacity for new knowledge are identified as most important for understanding the diffusion of STAN. These two factors provide the context within in which STAN is adopted. The structural factors reputation/prestige, hospital age, Centralization, Functional differentiation, External integration, Size and Organizational resources can moreover be considered less relevant in relation to STAN adoption.

8.1.3 Individual Characteristics

The individual characteristic competence and skills can be understood as having low importance to adoption and diffusion of the STAN-method. This factor deals with whether an individual has the competence to use an innovation or the intellectual capacity to learn how to use it (Ghodeswar & Vaidyanathan, 2007; Greenhalgh et al., 2004). All success cases investigated showed that it is possible to train users, both midwives and obstetricians, to be able to use the STAN-method. Therefore, it is clear that clinical professionals do have the intellectual capacity to learn how to use the STAN-method. Moreover, hospitals in which STAN was used little or not at all did not formulate any problems in relation to skill development. Rather, the problem lied with required training. Hence, competence and skills is of less importance as a factor.

The individual characteristic learning style was not possible to evaluate from findings in this study. Not enough information as gathered about the style of learning in order to generate any insights into its effect on adoption and diffusion of the STAN-method.

Needs, values and goals and motivation are however individual characteristics that are of importance. If an innovation corresponds to an individual's needs, values and goals, the motivation to adopt will be higher. At unsuccessful hospitals, the needs, values and goals of individuals were at odds with the STAN-method. At NÄL, individuals believed that births should be natural and not riddled with technology. Specifically, technology was generally thought to lead to over-interpretation and focus on non-existent problems. The situation was similar at Skåne University Hospital, where the idea that births should be natural and as little technology as possible should be used was described as a common aspiration among professionals. Such differences in values and goals also existed at SLL. However, here the situation was not mainly about technology per se but about lack of tradition in using guidelines and training on fetal monitoring. In other words, all three unsuccessful cases exhibit a controversy in terms of the values associated with using the STAN-method and those held by individuals at respective hospitals, decreasing motivation to adopt the method.

Comparing with success cases yields an interesting difference. At Ryhov, employees are very open to new technology and only a small minority exhibits the view that births should be natural. Oslo University Hospital also states that negative sentiments towards technology in relation to the STAN-introduction were minor and short-lived. Linköping University Hospital also displays a similar situation, adding that they experience that the resisting group of employees is very small and only one tenth of all personnel. The success case Mölndal Hospital similarly stated that while the natural births view has some traction, leaders have been successful in convincing their employees of the merit of technology, effectively influencing their values in a direction positive to the STAN-method. Halmstad Hospital was similarly able to apply pedagogy in order to convince resisting employees of the STAN-method's merit. St George's provides another example of influencing the values of employees, where obtaining buy-in from midwives was presented as the most important aspect of their successful STAN-implementation. It is clear from this comparison that the needs values and goals of clinical professionals must be aligned with those associated with the STAN-method. For example, reluctance of using new technology is a directly contradicting value, which may need to be influenced by leaders before adoption can be successful. Since needs, values and goals directly influence motivation to adopt a technology, it is clear that unsuccessful cases' divergent needs, values and goals contribute to the experienced barriers "philosophy of obstetric care" and "attitude towards technology".

Information is another important individual characteristic for adoption and diffusion of the STAN-method. This factor is however closely related to training, which has previously been compared. Training is conducted at a much larger extent at successful cases than at unsuccessful cases, and success in adoption is attributed by all successful cases as heavily dependent on extensive training efforts. Training can be understood as a means by which information is provided to the individual in how to use the innovation. Due to the importance of training for success, and the fact that the technological factor complexity has previously been determined as causing barriers to adoption and diffusion, it can be understood that information provision to individuals is critical for success.

The final individual characteristic is social networks, describing the social connections of the individual internally in the organization as well as externally. Large such networks lead to an individual being more exposed to knowledge and new developments, increasing the likelihood of adoption. It is clear in all successful cases that a person with significant external connections, in all cases a high-ranking clinical professional or chief of medicine, was convinced of the value of adopting

the STAN-method. These individuals, due to their experience and position in respective organization, were then able to convince others in their internal social network. There is no evidence that the social networks at unsuccessful organizations differ. However, in unsuccessful cases, no such high-ranking person with significant external connections was enthusiastically convinced of the STAN-method's merits. Therefore, it can be understood that which external social network that that these high-ranking individuals belong to is of large importance. For example, high-ranking individuals in SLL are likely to be connected mostly in the Stockholm region whereas high-ranking individuals in Mölndal in the West Sweden region. Since SLL is forcefully rejecting STAN, it follows that the social network of high-ranking individuals in SLL is likely to work against STAN adoption.

To summarize, Learning style and Competence/Skills were identified as less important in understanding STAN adoption while important individual characteristics were found to be Needs, Values, Goals, Motivation, Information and Social Network. These factors show that each individual's attitude towards STAN plays a role in the diffusion process. However this attitude is not fixed but can be changed through training and with influence from opinion leaders.

8.1.4 Internal Influencers

The structure and relative power of the members in the buying center was found to be similar in all studied cases, successful as well as unsuccessful. The buying center was generally dominated by a single influential and knowledgably person, often the chef of medicine that was able to convince the head of department to approve the investment in STAN. Based on this finding, the dynamics of the buying center as a whole was not considered crucial in understanding the diffusion of STAN within a hospital. Rather, it was more interesting to further analyze this single influential and knowledgably person who seemed to play a key role in adoption decision.

The diffusion of STAN within a hospital was found to be highly dependent on the impact from an opinion leader. According to findings, all successful cases involved a single person that acted as a powerful source of influence for the adoption of STAN. The adoption and implementation of STAN at Ryhov, Oslo University Hospital, Linköping University Hospital, St George's Hospital Halmstad Hospital as well as Mölndal Hospital was all lead by the chief of medicine. The chief of medicines at these hospitals showed common characteristics such as strong commitment and belief in the method, ability to convince and motivate the personnel and persistent work and long-term planning for full implementation with training of all personnel and changes in the daily work. However, hospitals that had not successfully adopted and implemented STAN lacked this kind of commitment from an opinion leader. For example at NÄL, despite still in use, the method gained little attention from leaders and the general enthusiasm towards the method among personnel was low. Furthermore, in the case of Skåne University Hospital in Malmö, STAN was placed in the basement when changing chief of medicine at the clinic, indicating the power of a single person's opinion. Based on these findings it is likely to suggest that the impact from an influential person is one of the most crucial factors in diffusion of STAN within hospitals.

In all success cases, the chief of medicine was the first person to introduce the idea of STAN to the clinic, which indicates that the chief of medicine not only was an opinion leader by also had the role of boundary spanner and acted as a linkage between the organization and the external environment.

To summarize, the most important factors in the area of Internal influencers is opinion leaders and boundary spanners. The opinion leader, which often also is boundary spanner, is found to be one of

the most crucial factors for the success of STAN at hospitals due to its power and control. The Buying center can be considered less relevant in considering the success of STAN adoption.

8.1.5 External Environment

In the case of STAN, the market was not found to be a crucial factor in understanding why some hospitals are able to successfully adopt and implement STAN and why some are not. First, the market, which is the needs of the populations, can be considered the same or similar for all studied hospitals. Second, the majority of deliveries are performed without any complications and babies are in general borne healthy, therefore there is no acute clinical need or pressure from the patients for this kind of technology. Similarly to market, networks and external connections is another factor that is not found to differ between the studied hospitals, and thus not found to determining the diffusion of STAN. None of the studied hospitals could be distinguished in terms of either strong or weak networks and external connections. It was common that the studied hospital used its connections with other organizations to compare if others already had or planned to adopt a STAN and further used it connections as references when making decisions. Thus, the diffusion of STAN was not found to be a matter of stronger networks and external connections but rather with whom the hospital is connected to and the opinion of this reference. Concerning the factors, political directives and regulatory laws, it was not possible analyze its potential impact based on the findings from the interviews.

Two factors in the external environment were found to have a substantial impact on diffusion of STAN within hospitals; those were journals, meetings, conferences and competition Professional journals, meetings and conferences, showed all to be important sources of information on STAN. In the studied cases, the first source clinics consulted to learn about STAN and establish an opinion about the method was research presented in journals, at meetings or conferences. In successful cases, those sources of information acted as inspiration to adapt STAN and reduced possible uncertainty regarding the method. However, in the cases of SLL and Skåne University Hospital those sources of information had the opposite effect, both SLL and Skåne University Hospital expressed distrust and skepticism towards the research as well as the method and was not convinced regarding any clinical benefits for the patient. Thus, this comparison illustrates how the external factor journals, meeting and conferences had a significant impact on the diffusion barrier “clinical benefits for the patient”.

Furthermore, competition was also found to impact a hospitals willingness to adopt innovations. Ryhov, Mölndal Hospital and St George’s Hospital all clearly expressed that competition with other hospitals, primarily in the country, was a strong motivator for adopting new technologies such as STAN. For example, Mölndal Hospital wanted to show its bigger brother Östra Hospital that they could accomplish better results in terms of reduced metabolic acidosis and operative interventions, Ryhov enjoyed being a pilot clinic for new technologies and was very proud of being appointed Sweden’s best hospital in the category of medium-sized hospitals and St George’s wanted to uphold its position as the leading clinic within obstetric in England. Halmstad Hospital in turn spoke positively about other hospitals’ representatives arranging visits to view how innovative methods or medical technology is being applied in, contributing to the understanding that a reputation for innovativeness can be an incentive from a competition-viewpoint. These findings, viewed together, show that competition can indeed act as a motivator for adopting the STAN-method.

To summarize, Journals, meetings and conferences as well as Competition were found to be the most relevant factors in the external environment. Existing research presented in journals, meetings and/or conferences is commonly used to establish an opinion regarding the relative advantage of STAN. The Market and the hospital's network and external connections were not found to be crucial factors in understanding why some hospitals are able to successfully adopt and implement STAN and why some are not.

8.1.6 Organizational Processes and Implementation

Implementation was found to be a crucial part of the diffusion process of STAN; implementation comprised activities that followed up and realized the decision to adopt the method. Based on the findings from the interviews it was not possible to analyze the decision making in relation to the implementation of STAN at the hospitals. However, all other factors related to organizational processes and to implementation were found highly relevant for successful diffusion of STAN within hospitals.

First, the success of implementation at a clinic was found to be highly dependent on strong leadership. This factor is closely related to the previous discussed factor opinion leader: the leader of the implementation was in all success cases the same person that also was opinion leader, i.e. the chief of medicine. Thus the chief of medicine was not only important in convincing the hospital to buy the STAN method but also actively involved in the implementation process to motivate all users to start using it. Since healthcare in general is a relatively conservative industry, it was found important that the leader was persistent and put in much time and to effort to realize the change. For example the chief of medicine at St George's Hospital explained that he himself had to convince and motivate all personnel to get engage in trainings and acquire the knowledge required for using the method. As stated earlier, the leader/opinion leader is found to be one of the most critical factors for successful diffusion of STAN within hospitals.

Second, findings showed that it was very important to dedicate sufficient resources to support the implementation of STAN. As discussed earlier in relation to organizational factors, the amount of available organizational resources as such was not found to be a determinant factor for successful diffusion of STAN since findings showed that resources was accessible as long as there were enough clinical benefits to gain. However whether those resources were in fact allocated to STAN or not was found very crucial for the success of the implementation. In successful cases of Ryhov, Oslo University Hospital, Linköping University Hospital, Mölndal Hospital, Halmstad Hospital and St George's Hospital, STAN was not considered only a device that could be purchased and installed in the delivery rooms, the method was given much attention and the clinics were aware that more effort was needed to successfully implement the method and have all personnel to start using it. Dedicated resources in those cases were mainly in terms of training, which in itself showed to be a critical factor for successful implementation of STAN. Since the usage of STAN were dependent on each users motivation and skills, much time and effort to involve, motivate, and train the users was required.

In unsuccessful cases, such as Skåne University Hospital and NÄL, the STAN-method seemed to be given little attention and insufficient resources were dedicated to train the users. For example at NÄL, the training over the past years had been inconsistent and several users, new as well as old personnel, did not feel confident in using the method any longer. As a contrast, Ryhov, Oslo

University Hospital, Linköping University Hospital, Mölndal Hospital, Halmstad Hospital and St George's Hospital all strongly emphasized the importance of regular training. At those hospitals, once the initial training and certification on CTG and ST analysis of all personnel was completed, the training continued in form of daily discussions or/and smaller training sessions to upheld and constantly improve the knowledge at the clinics. This daily attention and discussions about STAN indicate that the clinics had a clear internal communication and continuous feedback to the users regarding how to use the method and what to expect from it and how it affects the daily work, which enhanced the motivation among the users. It is clear from this discussion that the absence of dedicated resources and training contribute to the diffusion barrier "training and knowledge" identified in the pilot study. While leadership/opinion leader is one of the most important factors for successful diffusion of STAN within hospital, training can be considered to be the other.

Third, the choice of implementation strategy was found to have significant impact on the success of the implementation of STAN. As described in theory there are two general strategies for implementing a new technology in an organization, start small and spread the technology incrementally or do full implementation from the beginning (Van de Ven, 1991). Research have found that the latter strategy is often more successful than the first (Van de Ven, 1991). Analyzing the implementation strategy for STAN in the studied hospitals shows that full implementation can be understood partly in terms of number of devices and partly in terms of the amount of dedicated resources.

Concerning devices, none of the studied hospitals did implement a large number of devices from the beginning, both in the successful and unsuccessful cases the clinics started with few. However, what distinguished successful from the unsuccessful cases was that the successful cases, within a relative short period of time increased the number of devices. For example, Linköping went from two to 7 STAN devices within a year and the pattern was similar at Ryhov, Mölndal Hospital, Oslo University Hospital, Halmstad Hospital and St George's Hospital. Commonly, the clinics realized that it was not possible to be confident and knowledgeable on the method and achieve desired clinical effects with only a few devices; STAN needed to be used on a daily basis in order for all personnel to get used to it. In the case of NÄL and Skåne University Hospital, this escalation of devices and usage was never executed resulting in personnel feeling insecure and uncomfortable in using the method and therefore prioritizing other methods. Consequently, the clinics were not able to see any clear clinical benefits potentially resulting in even less usage. This could be compared to a negative spiral, which in the case of Skåne University Hospital in Lund resulted in the STAN-devices being placed in the basement.

Considering dedicated resources, the successful cases could be clearly distinguished from the unsuccessful cases. In all successful cases a substantial amount of resources was dedicated to STAN from the very first beginning of the implementation, primarily in terms of training and attention and involvement from leaders. Thus, findings indicated that, although starting with only a few devices, it was highly crucial for the clinics to do a full implementation in terms of training to be successful with STAN. In addition, it was important that leaders as well as all personnel were committed and actively involved from the beginning. As also pointed out earlier, the unsuccessful cases was characterized by insufficient resources dedicated to training and low commitment from leaders and personnel. According to theory, this is a common problem when not doing a full implementation (Van de Ven, 1991). When starting small there is a risk of lost attention to the STAN; as soon as the first devices

are introduced, leaders change its focus to other urging activities, STAN falls in the dark and the routines go back to normal. This pattern was clearly seen in the case of Skåne University Hospital.

St George's Hospital is a case that clearly illustrates the potential problems of few devices and few dedicated resources but also how this situation can be overcome to reach a successful implementation. St George's initially started with few devices and did only train a small number of obstetricians and midwives. This resulted in that only those that were very comfortable with the technology used it and STAN was thus used very irregular. An investigation of medical journals from this period showed that almost all cases of STAN usage involved elements of human error. St George's realized the situation was unsustainable and decided to change their goals related to STAN. Firstly, all relevant personnel were trained in the method as opposed to only a few selected ones. Secondly, more devices were purchased in order to signal that the hospital was serious about applying this method in fetal monitoring. Finally, the policy of STAN usage was changed, all patients that went on electronic fetal heart rate monitoring, or CTG, would also automatically be placed on STAN monitoring.

Finally, an important part of the implementation process that differs between successful and unsuccessful cases was the establishment of new routines and guidelines when introducing STAN. In all successful cases there existed clear guidelines on when, on whom and how to use STAN in order to ensure the method was correctly used and established in the daily routines and thus not forgotten. In contrast, at Skåne University Hospital in Lund, STAN was used randomly on patients, filling no purpose at the clinic. At NÄL the usage of STAN had decreased over the past years due to midwifes disregarding the method, indicating that there were no clear directives regarding how STAN should be established in the daily work.

To summarize, organizational processes and implementation is shown to be a highly critical area for the diffusion of STAN within hospitals; it is through effective organizational processes and implementation hospitals are able to ultimately realize the benefits of STAN. The most important factors in this area are Leadership, Dedicated resources, Training, Communication and feedback, Implementation strategy and Routines while Decision-making was found less important.

8.1.7 Revised Diffusion Framework

This section aimed to establish a deeper understanding of the diffusion process of the STAN-method within hospitals. Findings from successful cases and unsuccessful cases were analyzed and compared in relation to the diffusion framework for medical technologies presented in the theory section 5.1. The outcome of this analysis was a revised diffusion framework, see Figure 18 below, that contains those factors that are in particular important in understanding the diffusion and adoption of STAN specifically.

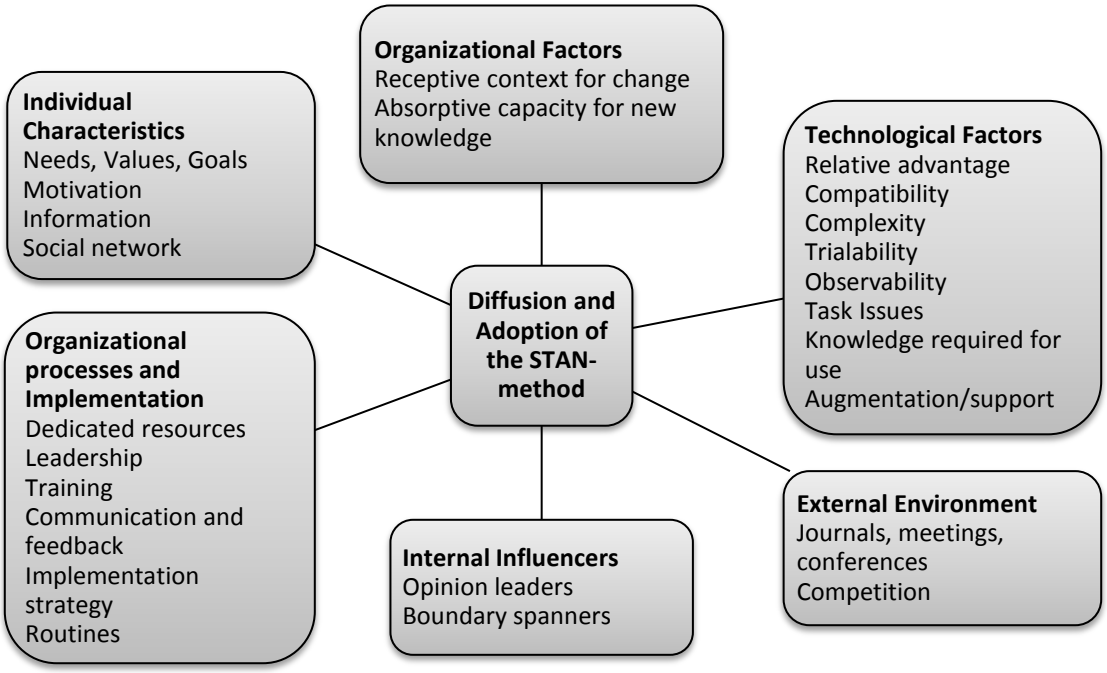

Figure 18. Revised Diffusion Framework explaining the Diffusion of the STAN-method

The most relevant technological factors were found to be Relative advantage, Compatibility, Complexity, Trialability, Observability, Task Issues, Knowledge required for use and Augmentation/support. Together those factors illustrated that the STAN-method has characteristics that in many aspects makes it challenging technology to spread.

Furthermore, important individual characteristics were found to be Needs, Values, Goals, Motivation, Information and Social Network. These factors showed that each individual's attitude towards STAN plays a role in the diffusion process, however this attitude was not fixed but could be changed with influence from opinion leaders and through training.

Concerning organizational factors, the two non-structural factors Receptive context for change and Absorptive capacity for new knowledge were identified as most important for understanding the diffusion of STAN. These two factors provided the context within in which STAN was adopted.

The most important factors in the area of Internal influencers were opinion leaders and boundary spanners. The opinion leader, which often also was boundary spanner, was found to be one of the most crucial factors for the success of STAN at hospitals due to its power and control.

Concerning the external environment, Journals, meetings and conferences as well as Competition were found to be the most relevant factors. Existing research presented in journals, meetings and/or conferences were commonly used to establish an opinion regarding the relative advantage of STAN.

Finally, organizational processes and implementation showed to be a highly critical area for the diffusion of STAN within hospitals; it was through effective organizational processes and implementation hospitals were able to ultimately realize the benefits of STAN. The most important

factors in this area were Leadership, Dedicated resources, Training, Communication and feedback, Implementation strategy and Routines.

8.1.8 Relative Importance of Revised Diffusion Framework Areas

As can be understood from the analysis above, all six areas of the diffusion framework are important in understanding how STAN is adopted and diffused within hospitals. However, specifically to address and overcome barriers to adoption and diffusion, some of the areas can be considered more relevant than others. In order to address and overcome barriers, Neoventa must exert influence and the amount of possible actions in each of the areas differs.

First, Technological Factors is an area that can be considered relatively fixed. The pros and cons of STAN are inherent in the method and are thus difficult to change in a short-term perspective. Concerning the area External Environment, Neoventa is already strongly focusing on furthering scientific research by supporting different studies on STAN, for example the ongoing study in in US. Thus, further actions within this area not urgent. Besides, the effect of further actions can be viewed as limited since it is only the amount of research and not the results that can be influenced. Consequently, Technological Factors as well as External Environment can be considered two areas in which possibility to influence for Neoventa is limited.

Moreover, Individual Characteristics and Organizational Factors are areas that, by their nature, are difficult for Neoventa as a company to directly impact. As discussed in the analysis, the factors within those areas are strongly dependent on the amount of training and the involvement and influence from opinion leaders. This means that Neoventa can indirectly impact Individual Characteristics and Organizational Factors through the areas Internal Influencers and Organizational Processes and Implementation.

Internal Influencers and Organizational Processes and Implementation were found to be two highly important areas due to large differences between successful and unsuccessful cases investigated. Oslo University hospital, Linköping University Hospital, Mölndal Hospital and St George's have all explicitly pointed out strong leadership from an opinion leader as one of the key success factors in adoption of STAN. This did not exist in any of the unsuccessful cases. Moreover, Organizational Processes and Implementation has proven to be a challenging part of the adoption process, where commitment from leaders and dedicated resources to training and new routines clearly distinguishes successful from unsuccessful cases. In fact, it is clear from the analysis that Internal Influencers and Organizational Processes and implementation are the two most critical areas in spreading STAN. Furthermore, findings from success cases show that Neoventa's efforts within those two areas have often contributed to successful adoption of STAN, indicating that Neoventa's opportunities to actually impact those two areas in order to promote diffusion of STAN are large. Therefore those two areas will be the main focus when further examining how barriers to adoption and diffusion of the STAN-method can be overcome by analyzing Neoventa's sales model. The two most relevant areas of the revised Diffusion Framework is illustrated in Figure 19 below.

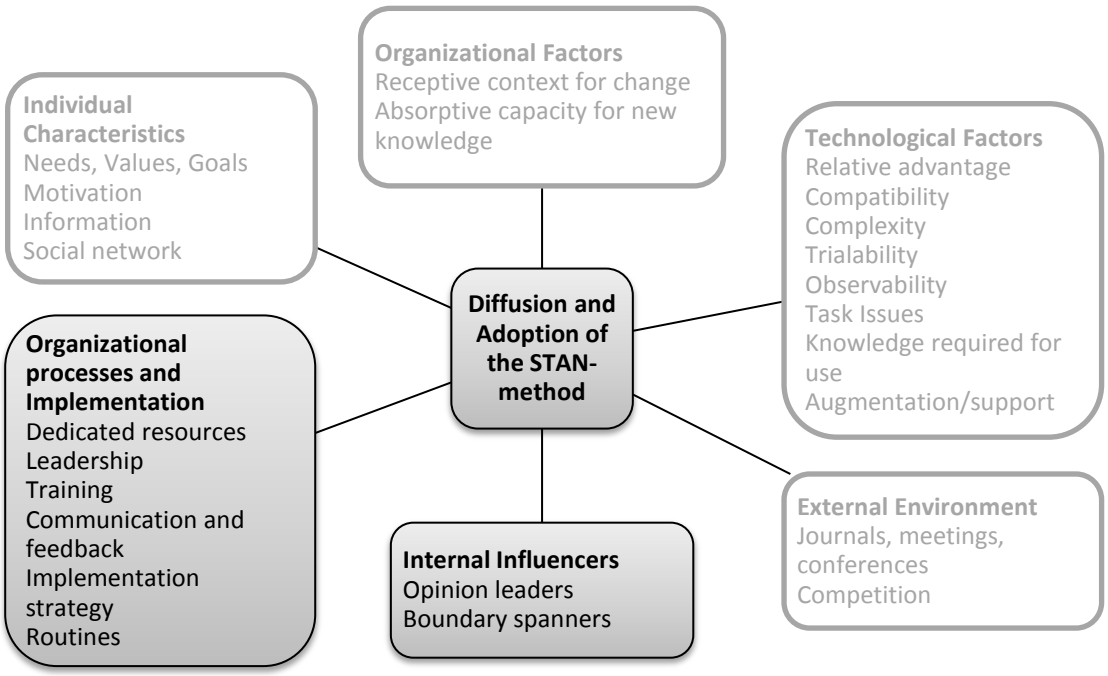

Figure 19. The Two Most Important Areas of the Revised Diffusion Framework

8.2 Sales Model Analysis

The aim of this section is to analyze the sales model of Neoventa in relation to the Technology Marketing Model and the revised diffusion framework, with focus on the two most important framework areas. As presented in theory section 5.2, the Technology Marketing Model aims at understanding how a company can act to promote diffusion of a technology offering. This section answers the second part of the main research question of this thesis. By comparing the Neoventa sales model with the Technology Marketing Model and the revised diffusion framework, an understanding of how the company can address barriers to adoption and diffusion can be reached.

Hospitals investigated in the pilot- and continuation study support the relevance of applying the Technology Marketing Model, which builds upon Rogers' (2003) Technology Adoption Life Cycle as presented in section 5.2 "Technology Marketing Model". In fact, the pilot study hospital Ryhov exhibited characteristics that are associated with a more open or innovative stance towards new technology. On the other hand, several other pilot study hospitals exhibited a more conservative view, namely NÄL, Skåne University Hospital in Malmö and in Lund and SLL. These could be placed in different categories on the Technology Adoption Life Cycle curve. Ryhov would in such an exercise belong to the early market whereas the other three hospitals would belong in the more conservative mainstream market. This illustrates that Neoventa is indeed dealing with a technology market with similar characteristics as described in Moore (1991), supporting the value of analyzing Neoventa's sales model with a theoretical foundation in the Technology Marketing Model. One characteristic that was especially clear was the tendency of hospitals to seek external references when evaluating STAN. At Ryhov, initial external uncertainty and controversy made it impossible to adopt STAN in the early period after its invention. It was not until the method later gained a certain degree of

acceptance that this hospital gained any real interest. Furthermore, all interviewees were keenly aware of the scientific status of the STAN-method and which other hospitals had adopted the method, also exemplifying a behavior of seeking external references.

As presented in section 5.2 “Technology Marketing Model”, the Technology Marketing Model consists of two main elements a company should focus on to promote diffusion of a technology offering. First, in order to “Cross the chasm”, a firm must choose a very specific target in the mainstream market and dominate it. The purpose is to conquer a customer, which subsequently can be used as a reference base to capture remaining mainstream customers. However, picking the right target is not enough to overcome the difficulties of technology markets. The firm must also ensure that the whole product is delivered to the customer. The whole product is the set of all products and services that are required by the customer to achieve the indented result. Those two elements, focus on the right target and deliver the whole product, will constitute the base for the succeeding analysis of Neoventa’s sales model. Likewise, the revised diffusion framework will be connected to each of those areas.

8.2.1 Focus on the Right Target

The great variation found in expressed opinions on the STAN-method among the studied hospitals stands in strong contrast with the Technology Marketing Model. According to the model, technology firms marketing a new technology should focus on a key target and ensure that this target enthusiastically adopts the product, referencing it to other similar adopters. Hence, the sales model employed so far by Neoventa has clearly not resulted in a stable and reference-able customer base.

The direct sales approach with subsidiaries in many markets which, was employed by Neoventa at the early stage of spreading the STAN-method, led to overextension of resources and had to be abandoned. In relation to the Technology Marketing Model, such a wide focus entails difficulties in targeting specific customers with overwhelming resources to ensure enthusiastic adoption. Therefore, the rationalization to a more focused organization was likely a good decision for Neoventa’s ability to achieve market traction. However, the company simultaneously underwent a period of ambiguity in terms of what the product should be for its customer, shifting from selling knowledge to a more product-centric approach and then back to knowledge again. Clearly, there has been a degree of uncertainty regarding the offering, which may have damaged the degree of focus in the sales organization.

Furthermore, since the reorganization of the sales organization away from the resource-intensive initial structure, there has been a perceived lack of resources. Lack of resources in sales combined with addressing multiple markets is likely to lead to difficulties in truly targeting key organizations rather than targeting a more general geographic market in a cost-efficient manner. Ensuring wholehearted adoption at key targets, and resulting referencing opportunities, then becomes difficult. In fact Neoventa has historically perceived it demanding to secure reference-able customers, explaining the situation with lack of sales strategy consistency as well as focus on selling single products rather than converting whole clinics. Selling single products can in the case of the STAN-method be viewed as contrary to the Technology Marketing Model. This was shown in the pilot study where it was found that hospitals using the method too sparsely, either because of too few installed units or for other reasons, were not able to realize the benefits from the method. Therefore,

selling single products and not a whole system to hospitals can be understood as not completely capturing the key target that is chosen.

It can be concluded from the above that Neoventa has historically lacked focus, this has likely been a result of limited resources invested in the sales organization, perhaps as a result of previous over-extension, as well as ambiguity in definition of the company's offering. The lack of focus has led to a situation where reference-able customers are few and many conservative hospitals are reluctant to adopt. The problematic situation can be understood by relating back to the revised diffusion framework and the area internal influencers. Considering what factors that determine the adoption and diffusion of STAN, support from opinion leaders was found to be one of the key success factors. With no focus and few reference customers, it is difficult for Neoventa to gain the support needed from opinion leaders, impeding the diffusion of the STAN-method.

However, while there has been lack of focus historically, the current sales model as detailed by the company paints a different picture. The company has begun to increase resources invested in the sales organization, an action that should provide more possibilities to target key hospitals. Furthermore, Neoventa is today emphasizing centers of excellence, hospitals where STAN adoption as well as knowledge is high, that are explicitly used as reference centers to potential adopters. Furthermore, the practice of selling single products has been partly abandoned in favor of selling larger amounts of products per customer. The case of the Neoventa sales organization in Netherlands is particularly illustrative, where a "Black or White" approach, or a lower limit on the number of units that an organization can purchase, has been implemented. Although there are drawbacks with this approach, such as higher up-front cost for an adopting hospital as well as higher burden in terms of organizational change requirement for those that choose to adopt, this is clearly in line with the Technology Marketing Model. From this, it can be concluded that Neoventa has changed its sales model from one with little focus to one with more resources and a clear focus on reference-able customers and larger amounts of units sold per customer. This change enables Neoventa to improve its reference base, which is critical in order to diffuse STAN to more conservative market segments. Relating back to the revised diffusion framework and the area of Internal Influencers, a strong reference base will most likely enable Neoventa to gain support from opinion leaders at hospitals that have not yet have adopted the method, ant thus enhance the likelihood of successful adoption at those hospitals. The question that remains, however, is why Neoventa is still facing such challenges in diffusing the STAN-method as were found in the pilot study, regardless of these changes.

Considering focus, there is still a remaining element that impedes a change towards a sales model consistent with the Technology Marketing Model, the indirect sales force. Neoventa is in the process of changing to a direct sales force on larger markets. However, this is done as a reaction to a large market penetration rather than as a tool to support diffusion. Neoventa clearly expresses that it only becomes warranted with a direct sales force in a market where penetration is high and such a sales organization can be supported. Hence, the company is forced to deal with a lower level of control in the initial phases of diffusion in a market. Arguably, this can explain why the change in sales model has not had a complete effect in terms of diffusion. Another element, which may still remain and impede change, is the large variation in approaches used on different markets. Sweden and Norway have direct sales forces whereas the UK, the Netherlands and Belgium have indirect sales forces. Indeed, the model is tailored to each market, which is illustrated clearly by the situation in the

Netherlands and Belgium. Each of these two markets has a completely different sales model considering the characteristics of the Technology Marketing Model. Due to differences in hospital size, the “Black and White” approach is used in the Netherlands while single-unit purchases are allowed in Belgium. Such tailoring between markets, even if warranted by local differences, may impede the ability to implement top-down change into the sales model and explain why success in terms of reference centers and more general diffusion into conservative market segments has been elusive.

To conclude, Neoventa’s sales model has historically suffered from limited resources and ambiguity in definition of the sales offering. This has resulted in lack of focus, which in turn has led to a situation where reference-able customers are few and many conservative hospitals are reluctant to adopt. However, the current sales model as detailed by the company paints a different picture. Today, Neoventa is trying to increase its focus by allocating more resources to sales, creating reference centers and selling larger amounts of products per customer. This change is in line with the Technology Marketing Model and should potentially enable Neoventa to improve its reference base, which is critical in order to diffuse STAN to more conservative market segments. However, Neoventa is still facing challenges in diffusing STAN. The explanation to this is likely difficulties to fully execute the new strategy in reality.

8.2.2 Deliver the Whole Product

According to the Technology Marketing Model, a company that has achieved a high level of focus in terms of targets must then ensure that the whole product is delivered to their customers. The whole product is the products and services required for the customer to achieve the intended result.

In terms of the STAN-method, several important elements of the whole product have emerged from findings. Training of users is perhaps the most prominent. Hospitals investigated were unanimous when describing that clinical application of the STAN-method required training users. Training, which is part of organizational processes and implementation in the revised diffusion framework, was further found to be important in changing the values of users, a part of individual characteristics in the framework. Attempting to implement the STAN-method without extensive training in place is therefore likely to mean that knowledge of the method remains too low but also that potential technology-adverse values remain in place among individuals at the maternity unit in question. Support is also a part of the whole product. Even if examples of success exist with little support, success cases all agreed that this was important in clinical application of the STAN-method.

Moreover, guidelines in how to use the method are a tool that is used in training and that has been emphasized by success cases as important in the implementation of the STAN-method. In fact, four out of the five success cases stated that guidelines are very important for success, and unclear guidelines for use were identified as a problem for unsuccessful cases. It can be understood from this that guidelines are a part of the whole product. Due to the referencing behavior of the customers in the medical technology market, as well as their constant scanning of scientific publications, another part of the whole product can be discerned. This is scientific credibility. In fact, the focus on scientific studies and the importance of a new fetal monitoring method’s scientific status was perceived by investigated hospitals as very high. Neoventa must therefore deliver scientific credibility with the STAN-method, making it a part of the whole product.

Neoventa initially followed a whole product approach, emphasizing not only the device itself but also super-user development and education. The shift to a commercial approach, which instead meant emphasizing sales of more devices, is inconsistent with the Technology Marketing Model and a whole product approach. In fact, as in the cases of investigated unsuccessful hospitals in this thesis, it is likely that new customers during this period received inadequate support and education, meaning that knowledge as well as use of STAN would likely have been low and optimal results may therefore have been difficult to achieve. The recent shift back towards what Neoventa describe as selling a concept or method rather than a product is promising in terms of installing whole products at their customers and realizing benefits from the STAN-method. In fact, emphasizing elements of the whole product such as education, support and the use of guidelines is likely to improve the perceived benefits after an adoption and contribute to quick full conversion of hospitals, which was previously identified as important to achieve. In turn, increased perceived benefits are likely to increase diffusion of the STAN-method due to referencing behavior between healthcare organizations. A whole product approach directly contributes to positively addressing the diffusion framework area organizational processes and implementation, foremost the factors training and routines.

There is further a controversy in Neoventa's historical attitude towards allocating resources to the sales function. At the time when Neoventa was focusing on the whole product and selling knowledge, resources allocated to the sales function were lower. With a more commercial focus, albeit unsuccessful and inconsistent with the whole product approach, resources to sales were increased. However, the Technology Marketing Model emphasizes both a whole product approach and large resources allocated to the target that is chosen to focus on. Still today, resources are viewed as limited, which is a large problem considering the previously discussed lack of clear focus and targets. In terms of the diffusion framework areas, limited resources mainly means that Neoventa is unable to ensure an adequate level of training and support in the area organizational processes and implementation. In turn, this may mean that existing technology-adverse values are left unchecked. However, it is clear from the current sales model of Neoventa that training and support is given a relatively large focus, which in turn is promising for delivery of a whole product. Increasing resources dedicated to sales in fact lead to a possibility to focus more on provision of training and support, which contributes to achieving full conversion of customers for the STAN-method. Moreover, these resources are also likely to be required in order to more consistently convince opinion leaders at each customer hospital of the merits of the STAN-method, as well as supporting that opinion leader in convincing others at the same hospital.

To conclude, the whole product in the case of the STAN-method consists of training, support, guidelines and scientific credibility. In order to successfully diffuse the method, these additional elements must according to the Technology Marketing Model be provided together with the STAN-method. Neoventa has historically had low emphasis on whole product components, which means that customers have received inadequate provision of them. This has affected customers' perceived benefit of the method negatively, which in turn has reduced diffusion of the STAN-method to other hospitals. Recently, whole product emphasis has increased, as has the amount of dedicated resources to sales. Dedicate more resources to sales is not contradictory to a focused whole product approach, but is necessary in order to fully convert hospitals and their opinion leaders.

9. Conclusion

This chapter presents the conclusions of the thesis by answering the pilot- and the main research question. The answer to the pilot research question, dealing with the existence and nature of barriers to adoption and diffusion of the STAN-method, consists of five barrier parameters. The answer to the main research question, dealing with what Neoventa can learn from this study, is presented in terms of three learnings.

The purpose of this thesis was to understand the nature and implications of experienced barriers to adoption and diffusion of the STAN-method and to further identify what factors are relevant for Neoventa when seeking to address these barriers in the near future.

The first part of the purpose was addressed by the pilot study, which aimed to answer the question "*What barriers to adoption and diffusion of the STAN-method exist, and what is their implication for Neoventa in spreading STAN?"* The pilot study resulted in five parameters that were found to represent the main barriers to diffusion of STAN within hospitals. Those were Clinical benefits for the patient, Decision-making support, Training and knowledge, Philosophy on obstetric care and Attitude towards technology.

The second part of the purpose was addressed by the continuation study. The findings from the descriptive sub questions one and two was ultimately synthesized and analyzed in the main research question: "*What are the differences between successful and unsuccessful cases, and what can be learned from these differences, in order to overcome barriers to adoption and diffusion of the STAN-method at hospitals in general?"* This question resulted in three main learnings for Neoventa.

The first learning for Neoventa is that the two diffusion aspects Internal Influencers, mainly consisting of opinions leaders, and Organizational processes and Implementation, with important factors such as dedication of resources, leadership and training, are the most critical areas to address in spreading the STAN-method. These areas were found to have the largest impact on the adoption decision of hospitals. Furthermore, differences between success cases and unsuccessful cases were in these aspects the most clear. Low commitment in the implementation process and absence of opinion leaders that enthusiastically supported the method were found to be essential causes for limited success. Finally, it is also in these two areas Neoventa has the largest opportunity to actively impact the adoption decision, making them the most prominent candidates for further action on behalf of Neoventa.

The next learning is that a historical lack of focus, not only in terms of ambiguity in Neoventa's offering and sales strategy but also in terms of limited sales resources, has contributed to the experienced barriers to adoption and diffusion of the STAN-method. The lack of focus has resulted in large variation of expressed opinions on the method among customers, and a situation where reference-able customers are fewer than desirable. Since the medical technology market is particularly reference-prone, this is strongly contributing to the reluctance to adopt of more conservative hospitals such as investigated unsuccessful cases. The recent attempts to increase focus by allocating more resources to sales, creating reference centers and emphasizing sales of larger amounts of units per customer can therefore be understood as promising in attempting to overcome barriers to adoption and diffusion. In fact, this development is in line with the Technology Marketing Model, which is part of the theoretical base of this thesis. The learning for Neoventa is therefore that such focus-increasing actions should enable the company to improve its reference base, something

that is critical in order to diffuse the method among more conservative customer segments. One remaining challenge is to execute this renewed focus strategy despite partly employing an indirect sales force and decentralized, locally varying sales tactics.

The final learning is that Neoventa must deliver the whole product, which consists of several other components than a STAN-unit. In order for customers to not only adopt STAN but also to realize the intended results, or benefits, of the adoption, Neoventa must also deliver training, support, guidelines and scientific credibility. Among investigated unsuccessful cases, sparse use of the method as well as lack of whole product components emerged as contributing causes to unsatisfactory outcome of the STAN-adoption. Neoventa's historical shift away from a whole product mentality, which did initially exist, to a more commercial single product mentality has contributed to the creation of dissatisfied customers. These, in turn, negatively impact the diffusion process of the STAN-method. However, Neoventa is today returning to a whole product approach, emphasizing the creation of reference centers. The learning is therefore that provision of the whole product is likely to encourage quicker and fuller conversion of hospitals to the STAN-method. However, this requires a high degree of focus as well as adequate resources dedicated to the sales function, both of which have periodically been in short supply at Neoventa. Quick and full conversion will in turn contribute to faster diffusion of the STAN-method, driven by the market's characteristic referencing-behavior.

10. References

Below, references from interviews, from online sources and from printed sources are presented.

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11. Appendix

Below, a representative template developed for an interview with a Chief of Medicine and Chief Midwife is presented.

Chief of Medicine or Chief Midwife

Background	Describe in short your background and experiences with STAN	• How long have you been using STAN?
Opening Question	How is STAN used at the hospital today?	• Describe the general working process with STAN, including all necessary working moments.
Opening Question to reveal the top of the mind - opinion	What is, in your opinion, the pros and cons of the STAN method?	
Parameter	**Question**	**Probe**
Time	How does the STAN-method affect the time it takes to perform daily tasks?	• Is the STAN-method more or less time-consuming? • Any in particular time consuming moment?
Complexity	How does the STAN-method impact complexity of the working process at the hospital?	• Additional or fewer working moments? • Is the working process perceived as simple or difficult? In comparison to CTG and/or FBS?
Usage	How is the STAN-method experienced from a usage perspective? Is the STAN-method considered easy or difficult to use?	• Are the working moments difficult to learn?
Product placement	How does the STAN-method's medical device fit into its intended surroundings?	• Appropriate and user-friendly product design? • Is there enough space for the device in the delivery rooms?
Responsibility	Does the STAN-method imply any redistribution of responsibilities at the hospital?	• Any differences in responsibility between obstetricians and midwifes?
Clinical benefits for the patient	What benefits for the patients does the STAN-method provide?	
Decision-making support	Does the STAN-method impact employees' abilities to deliver a good treatment to patients?	
Training	Does the STAN-method require more or less training compared to other medical devices or methods?	• Is there enough time dedicated to training? • Is the training perceived as valuable?
Knowledge	Does the STAN-method impact knowledge regarding delivery of babies, fetal physiology and fetal monitoring in general?	
Cost	How are the clinic's costs affected by using the STAN-method?	• How are the costs affected using the STAN-method in comparison to other methods, FBS and/or CTG?
Purchasing-process	What did the purchase process look like in the case of the STAN-method?	• Who was involved in the purchasing process? • Did the clinic test or investigate the method in any particular way before purchase?