Enterprise System Post-Implementation: A Practice of System Evaluation Issues in Health Care Organization
A case study of Jönköping County Council

Bachelor’s thesis within Informatics

Author: Sintset Gilles
Xinyi Yu
Yiping Zhang

Tutor: Daniela Mihailescu

Jönköping August 2011
Acknowledgement

We would like to dedicate thanks to our tutor Daniela Mihaiescu, who gives our suggestions and inspires us. She helps us with our work and encouraged us in order to perfect the thesis. Thanks to dear Agnetha Södergård, the XROS project leader and Sara Kamfors, the health care administrator. Thanks for giving us the opportunity to conduct the research. We are so appreciate their helps. Without their helps, we would not be able to finish the thesis successfully. We also should say thank you to our colleagues, classmates and friends, thanks for giving us your suggestions and feedbacks. We would not be able to improve our work without your comments.

Thank you for everyone!

Antset Gilles, Xinyi Yu, Aiping Zhang

August 2011, Jönköping
Abstract

Introduction: As Information Technology (IT) becomes more and more advanced, the Enterprise System (ES) starts to attract researcher’s attention. While with the high rate of failure IT projects, it is important to evaluate the IT project properly. This paper conducts a case study in the Health Care area and chooses Jönköping County Council’s ROS system to be the target system. According to the established linkage between theory and real world organization, a practice of Enterprise System Evaluation is conducted by using an existing Uwizeyemungu et al.’s Enterprise System Effects Evaluation Model (ESEM). The research questions are as follows:

1. What are the Enterprise Systems Effects which impact on business processes?
2. To what extend do the ES effects impact on the business processes?

Purpose: the study is an exploratory study that aims at identifying what are the ES Effects which impact on the business processes and assessing the importance and the actual degree of these effects. The answers of the first goal are explored by analyzing the documents and the record of interview, and the results are the basis of the second question.

Method: This research has adopted a combined approach because of the nature of the research questions. Data has been collected through face-to-face interview, survey and the organizational documents. Secondary data are also be used for analyzing. Both qualitative and quantitative data are used for getting a reliable conclusion.

Conclusions: The Enterprise System effects can be categorized into automaional effects, informational effects and transformational effects. The relationship between such effects and Performance indicators are very important. By determining the importance and impacts degree of such relationships, the evaluation results can be explicitly calculated and understood.
Definition

**Business process:** A business process or business method is a combination of related, structured activities which create a specific service or product (serve a particular object) for a particular customer or customers. (Mooney et al. 1996)

**Enterprise System (ES):** Enterprise systems or ERP systems are comprehensive software applications that integrated various functionalities and support critical organizational functions in order to achieve the organization’s goal of enhanced effectiveness and efficiency in their business processes. (Moticalla & Thompson, 2009)

**Enterprise System Characteristics:** Common characteristics that an enterprise system is equipped with, which including integration, module support, data warehouse and so on.

**Enterprise System Implementation:** A continuous process which have three phases: pre-implementation, implementation and post-implementation; the whole process of implementation is complex, time consuming and resource intensive.

**Evaluation:** Assessing the outcomes of the enterprise system implementation comprehensively in order to judge the success of the implementation.

**Östergötland County Council:** is called Landstinget i Östergötland (LIÖ) in Swedish, which is the health care organization in Östergötland in Sweden, implemented ROS system together with Jönköping County Council.

**Jönköping County Council:** is called Landstinget i Jönköpings Län (LJL) in Swedish, the, which is the health care organization in Jönköping Län in Sweden.

**Performance indicator (PI):** Performance indicator is a term for performance management. It can be used in an organization to measure either a particular activity of the organization performance as a whole.
# Table of Contents

1 Introduction .............................................................................................................. 1  
  1.1 Problem discussion ............................................................................................. 2  
  1.2 Research Questions ............................................................................................ 3  
  1.3 Purpose ................................................................................................................ 3  
  1.4 Perspective .......................................................................................................... 3  
  1.5 Delimitation ........................................................................................................ 4  

2 Methodology ............................................................................................................. 5  
  2.1 Research approach ............................................................................................... 5  
      2.1.1 Combined approach ..................................................................................... 5  
  2.2 Research purpose categorization ....................................................................... 6  
      2.2.1 Categorization of research questions ......................................................... 6  
  2.3 Research strategy ................................................................................................. 7  
      2.3.1 Single case v. multiple case ....................................................................... 7  
      2.3.2 Holistic v. embedded ................................................................................. 8  
  2.4 Research method ................................................................................................ 8  
  2.5 Data collection ..................................................................................................... 9  
      2.5.1 Primary data ............................................................................................... 9  
      2.5.2 Secondary data ........................................................................................... 11  

3 Frame of reference .................................................................................................. 12  
  3.1 Enterprise System .............................................................................................. 12  
  3.2 Enterprise System Implementation life-cycle .................................................... 14  
      3.2.1 Pre-implementation & Implementation Phase ........................................... 14  
      3.2.2 Post-implementation Phase .................................................................... 15  
  3.3 Enterprise System Evaluation Model (ESEM) ............................................... 17  
      3.3.1 ESEM - Understand the implemented ES Characteristics ...................... 18  
      3.3.2 ESEM – Affected business processes ....................................................... 19  
      3.3.3 ESEM - Identify performance indicators (PIs) ......................................... 21  

4 Empirical data ......................................................................................................... 23  
  4.1 Jönköping County Council ............................................................................... 23  
      4.1.1 IT center in Jönköping County Council .................................................... 23  
  4.2 The ES implemented by Jönköping County Council ......................................... 23  
      4.2.1 The motivation of adopt an Enterprise System ........................................ 23  
      4.2.2 XROS project started ............................................................................. 24  
      4.2.3 ROS system changed business processes .............................................. 25  
  4.3 Determine the Degree of System Impacts ......................................................... 28  
      4.3.1 Determined by Users .............................................................................. 28  
      4.3.2 User suggestions ....................................................................................... 31  

5 Analysis .................................................................................................................. 33  
  5.1 Automational effects perceived ......................................................................... 38  
  5.2 Information effects perceived ........................................................................... 39  
  5.3 Transformational effects perceived .................................................................... 41  
  5.4 ROS System Final Evaluation Results ............................................................... 41
6 Conclusion ................................................................................................................. 42
6.1 Further study ......................................................................................................... 43

List of references ........................................................................................................ 44

Appendix
Appendix 1 Ros system testing Environment ................................................................. 47
Appendix 2 Interview Questions .................................................................................. 48
Appendix 3 Performance Indicators (PIs) .................................................................. 49
Appendix 4 ROS System User Satisfaction Survey (English Version) ....................... 50
Appendix 5 Seven Steps of ES Evaluation Method ..................................................... 53

Figures
Figure 3.1.1-1 Integrated system – Enterprise System
Figure 3.1.1-2 Integration of Enterprise system component
Figure 3.2-1 Enterprise System Implementation Life Cycle
Figure 3.2.1-1 Pre-implementation & implementation phase
Figure 3.2.2-1 Post-implementation (post-production) Life cycle chart
Figure 3.3-1 Evaluation Model of Enterprise System Effects (ESEM)
Figure 3.3.2.1-1 Business processes typology
Figure 3.3.2.2-1 System Effects framework
Figure 4.2.3-1 New business process and Performance Indicators (PIs)

Tables
Table 2.6.2.1-1 Key words are used to search for literatures
Table 3.3.1-1 Typical Characteristics of Enterprise System
Table 4.2.1-1 Motivations and Importance for ROS system adoption
Table 4.2.2-1 Summarized XROS project
Table 4.2.3-1 Categorized system effects affect business processes
Table 5-1 Summarized results of ROS system effects and their impact on corresponding performance indicator
1 Introduction

This section has a background and a problem discussion about the use of IT in health care, enterprise system implementation, relevant evaluation issues. The problem discussion of this study is followed by the research questions. Other sub-sections include purpose, perspective and delimitation.

In 2010, Swedish health care system has been ranked at top of most comparative analysis of various international health care systems (Baker, 2010). The great success of Swedish health care system has achieved, one has to appreciate the large investment in Information Technology (IT). As the increased IT cost has been an important part in the daily operation of Swedish health care, it is necessary to look for an appropriate way for controlling and managing the utilization of IT. Additionally, Köbler et al (2010) point out that the appropriate utilization of IT may offer strategies (Piccoli & Ives, 2005) and thus opportunities for differentiation within the health care sector.

As the use of IT to support business activities has accumulated significant benefits, more and more business activities realize the importance of IT (Bernroider, 2007). As the development of technology, increased number of IT products has been produced to support the daily working process in an organization (Carr, 2003). One of the most popular IT products which are widely mentioned today is called “Enterprise System”. An Enterprise System (ES) allows an organization to automate and integrate the major business processes in order to achieve the organization’s goal of enhanced effectiveness and efficiency in their business processes (Moticalla & Thompson, 2009). The popularity of Enterprise System has begun to grow in the early 1990s, which has been called Materials Requirement Planning (MRP) system. As several evolutions in the following years, MRP has been changed to MRP II, which focuses on enterprise-wide business inter-functional coordination and integration. This later system had added more functions such as customer relationship management (CRM), project management (PM), human resources management etc. Furthermore, as mentioned that the greater number of IT have been introduced in health care organization, the greater number of software vendors start to focus on this special area. In 1990, the first health care Enterprise System (ES) has appeared to support healthcare industry (Crane, 2003). Soon, more and more health care ES vendors come into view, such as SYSPRO, HealthLine Systems and Cosmic etc. The prosperity of ES in the health care area encourages the enthusiasm of IT industry to develop more IT products to support the organization processes in health care area.

Moreover, as enterprise systems have greatly benefited some health care organizations and facilitated them to improve their strategic advantage, it has become progressively important to think about the ES implementation and evaluation issues (Motwani et al., 2002). A successful implementation can bring continuous benefits to the organization (Motiwalla & Thompson, 2009). Therefore, it is necessary to use proper evaluation method to determine the contribution of IT in order to avoid failure which leads an organization to a disaster (Uwizeyemungu et al., 2009). Yasar et al. (2000) states that a successful enterprise system implementation is not only depending on the pre-implementation and implementation, but also up to a successful post-implementation. Maintenance and support the system can build
a stable working environment for an organization. Therefore, the post-implementation phase is an appropriate period for evaluating the system effects and other system performance. The outcomes of the post-implementation also can be used to measure the gap between expectation and actuality of the system effects.

1.1 Problem discussion

The post evaluation issues have been an interesting topic for both managers and researchers in the recent years (Uwizeyemungu et al., 2009). However, most researches focuses on the implementation phase (Bernroider, E.W.N, 2007, Karimi et al, 2007, Motvani, 2005). There is few study concern with the evaluation issue within post-implementation phase. A number of studies prefer to focus on maintenance or training issues rather than evaluating the system effects in the post-implementation (Presley, 2006; Hong & Kim, 2002).

Actually, post-implementation presents a stable period for an organization (Motiwalla & Thompson, 2009). There is a good opportunity for exploring the relationship between implemented system processes and corresponding business processes (Uwizemungu et al., 2009). Uwizemungu et al. (2009) also suggests that it is important to evaluate the implemented ES system characteristics by using a combination of existing evaluation model in the post-implementation phase.

In addition, comparing with business industry, the use of ES in health care area is relatively late (Baker et al., 2010). Health care organizations have complicate business process and need more IT functionality to support their daily activities. Thus, ES customizations are become progressively important for them to achieve better performance (Davenport, 2000). , Uwizemungu et al. (2009) also states that the evaluation of system effects can be used to compare the expectation with actuality. Within the post-implementation phases, the stable period as a platform shows the relationship between the system and organization. It is easy to evaluate these outcomes which are overrated or not compared with implemented system process.

According to the above problem discussion, there are several research motivations given to the system effects evaluation issue. This research hopes to conduct a practice based on the previous knowledge in order to establish best practice in solving the evaluation issues during the post-implementation phase in health care organization.
1.2 Research Questions

In order to lead readers to understand the targets of this paper straightforwardly, some research questions have been structured. The questions will be as follows:

1. **What are the Enterprise Systems Effects which impact on business processes?**

The aim of this question is to find out what the Enterprise System Effects are. In order to identify these system effects, it is primary to find out implemented system characteristics and business processes which are affected by such implemented system characteristics. In the context of this paper, the enterprise system effects are classified into three types, and the affected business processes are categorized according to the three system effects. Therefore, this question includes three sub-questions:

a. What are the implemented Enterprise System Characteristics?
b. What are the affected business processes?
c. What are the relationships between such system characteristics and corresponding business processes?

2. **To what extend do the ES effects impact on the business processes?**

From the first research question, the affected business processes are identified and categorized accordingly. Based on this, performance indicators (PIs) will be defined for the business processes. The PIs will be scored by both of the users and the project leader and will be analyzed according to the theory. The evaluation of how much the business processes are affected by the Enterprise System effects will be done by summarizing the scores of the PIs.

1.3 Purpose

The purpose of this thesis is to conduct a case study in Jönköping County Council and the studying object is one of their projects called XROS. The focus is mainly on evaluating the implemented ROS system by analyzing the relationships and degree of impacts between enterprise systems effects and affected business processes. The research will enrich the knowledge of enterprise system effects in the post-implementation phase and provide sources to further studies in this area. As for the organization, the research may help them to evaluate their project and thus better manage it.

1.4 Perspective

There will be different opinions by different perspective, so it is important to decide which perspectives to take before the research. As the evaluation of system is a very complex process which contains many aspects, choosing appropriate perspective will be helpful to collect useful data.

The paper is based on both the project leader’s perspective and the user’s perspective of the ROS system. The main aspects investigated include the data sharing, user interface, system usability and so on. As many research suggested, many project leaders have different
views of the system from the users. In the context of this paper, it is hard to have an objective view from a single perspective. Project leader may be over optimistic or exaggerate the system effects while the users may be lack of general impressions of the whole system. On the other hand, the model used in this paper also requires data from both perspectives. Based on these reasons, it may increase the credibility of the paper by taking both top-down and bottom-up perspectives. As the focus of the research is the project team, the system and organizational processes inside the Jönköping County Council, the software vendors and the Östergötland County Council is not in the consideration.

1.5 Delimitation

How ES affect the organizational processes has drawn a lot of attentions of researchers as the ES becomes more and more important in the business world. However, as the searching of literatures continues, it was found that most researches focus on managing ES effects on a general level, in pre-implementation phase or implementation phase. Thus this research focuses on how ES affect the corresponding business process in its post-implementation phase and addresses local-level rather than organizational-level. Moreover, this paper presents detailed discussion about the ES solution in health care area by conducting a case study on the ROS system, which is an ES health care solution provided by EDB. The scope is limited within the XROS project in only Jönköping County Council. The connection between Jönköping County Council and Östergötland County Council or other software vendors will not be included.
2 Methodology

In this chapter, the research methodology use to conducts the research is presented and validated. The presentation of this section includes discussions on research approach, research purpose categorization, research methods, research strategy, and data collection. Credibility, reliability and validity are discussed in the following.

2.1 Research approach

Easterby-Smith et al (2002) suggested that choosing a suitable approach for the research is important since it will influence the research design, strategies and help researches to overcome the constraints (cited in Saunders, Lewis & Thornhill, 2007). According to Saunders, Lewis and Thornhill, two approaches are usually adopted by researches, induction and deduction. Each of the approach has its own strengths and weaknesses, thus it is the nature of research questions that decides which approach should be taken. This chapter will elaborate on the characteristics of both approaches and state the reason for choosing a particular approach.

Deductive research is of most effective when enabling a cause-effect relationship and it focuses on testing theories. A deductive research is suitable for those who have resource limitations or wish to complete the research within the time scale. As the purpose of the research is clear, it will take less time and resources to finish the research. The alternative choice of research approach is inductive approach, which means to build theories. Theories will follow data rather than vice versa as with deduction (Saunders, Lewis & Thornhill, 2007, P118). Deductive research does not imply how humans interpreted their social world; however, it is the strength of inductive approach (Saunders, Lewis & Thornhill, 2007, P118). Conducting an inductive study can be resource consuming and it is possible that the efforts were made in vain. Researchers that decide to take an inductive approach should also consider the risks inherent in it.

2.1.1 Combined approach

Not one single approach can be perfect for this article because of the nature of the research questions. As for pure deductive approach, it is rigid and limited within a few predefined cause-effect relationships. In the context of this paper, it is difficult to conduct a pure deductive research. For instance, the ES system may affect the organizational processes of the Jönköping County Council in various ways, a deductive research can be used to reject a few hypotheses, but it is difficult to find out what are the correct answers. An inductive approach is likely to be particularly concerned with the context in which such events were taking place (Saunders, Lewis & Thornhill, 2007, P119) but it is not realistic to take a pure inductive approach within the resource limitation.

Considering the research questions and the resource limitation, a combined approach should be adopted for the research. This approach should possess the advantages from both inductive and deductive approach – ‘fast’ to use, resource-saving, concern about the context of the Jönköping County Council and the answers should not be limited in a few hypothesis. Thus, it may be more accurate to say that the approach extracts the advantages
from both inductive and deductive approach rather than bonding the approaches rigidly. In order to achieve this, certain theories were chosen to build the theoretical framework, which will ensure the data collected for further analysis are useful. The effects of the Enterprise system to business processes will be explored from the empirical data, which is more like an inductive study as the results are unknown and will be observed from the data. The identified effects will be evaluated according to the formula, and thus to get result of how important these effects are, which is more of a deductive way as it is to test a theory. The advantage of conducting research in this way is that the inductive research will consider the context of the Jönköping County Council and the result will not be limited in the hypothesis while on the other hand, the theoretical framework will give help to decide what kind of data need to be collected and ensure a useful conclusion from the analysis, and thus to save resources.

2.2 Research purpose categorization

According to Saunders et al (2007), the research purpose can be categorized as exploratory study, descriptive study and explanatory study. In this chapter, the characteristics of those categories will be specified and the purpose of this paper will be defined.

The focus of exploratory study may be broad as the aim of this study is defined as to find out what is happening; to seek new insights; to ask questions and to assess phenomena in a new light (Robson, 2002, cited in Saunders, Lewis & Thornhill, 2007, P133). It can be difficult to define a theme but it does not mean that the research has no direction; it is necessary to narrow down the focus as the research progressing. Robson (2002) defined the objective of Descriptive study is to portray an accurate profile of persons, events or situations (cited in Saunders, Lewis & Thornhill, 2007, P134). A pure descriptive study may be considered lack of insight, thus this type of study is usually combined with the other two types of study as an extension. Explanatory study aims at establish causal relationships between variables (Saunders, Lewis & Thornhill, 2007, P133). Both quantitative data and qualitative data can be used to explain the relationships between variables.

2.2.1 Categorization of research questions

While choosing research approach, it is also important to think about the research purpose. The research purpose is not limited in only one category depends on the research questions. For the first research question of studying ‘What are the Enterprise Systems Effects which impact on business processes’, it can be interpreted as identifying the effects that ES effects impact on the organizational processes, which means to explore what are happening in the organization. The data will be collected by doing interviews with the project managers and the CIO and from the organization documents. So it is appropriate to say that this question requires an exploratory studying.

The second question is ‘To what extend do the ES effects impact on the organizational processes’. Questionnaires will be sent to both users and project leader to investigate in the importance, actual results and the expectation. To sum up, the second question can be also categorized as exploratory study, as this question aims at assessing a phenomenon with the
chosen theory. The second research question is related to the first one in the way that this question is investigated on the base of the first question.

2.3 Research strategy


2.3.1 Single case v. multiple case

It is suitable to use a single case study when the case is representative, critical, extreme or unique. According to Saunders et al, a single case study also allows researchers to investigate a particular phenomenon in an organization that few have observed before. As an alternative, researchers can also adopt a multiple case study to generalize the result.

In the context of this paper, only one case, Jönköping County Council is chosen because the research will focus on studying the implemented ROS system (ES) which is belong to the XROS project in the county council. Saunders et al suggest that it is difficult to choose an actual case in single case studies. The reason of choosing the Jönköping County Council will be discussed in the following part. According to Baker et al. (2010), Jönköping County Council is considered as a high performing healthcare system and started to draw researchers’ attentions in the world. Taking the organizational context into consideration, the organization is not a normal business organization. The Jönköping County Council managed all the patients in Jönköping and is connected to other County Councils, which means that the Jönköping County Council is a large organization and is representative in the health care area. Jönköping County Council believes that the reason behind the high reputation is at least partly due to their management of IT (Baker et al., 2010), thus it can be attractive to know how the project is managed in the organization. What’s more, the ROS system has already turned into the post-implementation phase which provides stable IT environment, thus it is a good opportunity to observe the project to finish the research. The managers in the Jönköping County Council are also interested to see the evaluation of the project in the post-implementation phase, as there is no systematic system evaluation methods yet. Based on these arguments, one can say that the Jönköping County Council’s ROS system is suitable to be selected as the object of the single case study.

This research adopted a single case study strategy, so it is important to discuss the generalizability of the findings. The single case study may seem lack of generalizability at the first glance as there is no comparison in the research. However, Bryman (1988) suggested that the difference between a survey sample and a case study may not be so big if the case invariably examines a wide range of different people and activities (cited in Saunders, Lewis & Thornhill, 2007, p327). What’s more, if the case is related to the theories and aims at examine the relationship between the theories and the case; there may be a broader theoretical significance (Marshall and Rossman, 1999, cited in Saunders, Lewis & Thornhill, 2007,
Based on these arguments and what have been discussed above, it is appropriate to say the case is generalizable in the health care context.

2.3.2 Holistic v. embedded

Holistic case study views the organization as a whole while embedded case study examines one or more sub-units in the organization. According to Saunders et al, even if the researcher views the organization as a whole, as long as the examination of sub-units is involved, the research can be called an embedded case study (Saunders, Lewis & Thornhill, 2007). Based on this, the research can be viewed as an embedded case study.

2.4 Research method

The data type can be categorized as quantitative data or qualitative data depend on whether it is numerical data or not. Data collection technique and analysis procedures are differentiated regarding what type of data they are dealing with. Saunders et al (2007) argue that depending on what data collection technique and analysis procedures are adopted, research method can be differentiated into qualitative and quantitative method. It is allowed to choose either single data collection technique and analysis procedures or multiple data collection technique and data analysis procedures (Saunders, Lewis & Thornhill, 2007, P145). The choice of the method can be specified as mono method, multi-methods and mixed methods. In the following part of this chapter, a description of the difference between the methods will be given and the choice for the paper will be specified.

Mono method refers to the researches that adopt only single data collection technique and related data analysis procedures (Saunders, Lewis & Thornhill, 2007, P145). The research can use quantitative data collection technique such as questionnaire and responding data analysis procedures or qualitative data collection technique and analysis procedures. Multiple methods can be specified as multi-method and mixed methods. According to Saunders et al, the difference between these two kinds of method is that multi-method adopts either a quantitative or qualitative view of the world, which means in a multi-method study, although data can be collected either quantitatively or qualitatively, the data analysis will be only quantitative or qualitative, while mixed method generally means that both quantitative and qualitative data collection technique and analysis procedures are adopted.

As for the requirements of the research questions in this paper, literatures, organizational documents, non-standardized interview and survey will be employed to collect data and both qualitative and quantitative data analysis procedures will be used, which is to say that mixed methods research will be taken. According to Saunders et al (2007), mixed methods can be further specified into mixed-method and mixed-model research depending on whether the data analysis procedures are combined. Based on this argument, the research is thus categorized as a mixed-method research. As what has been briefly stated in the previous chapters, the interview will be used to identify the effects that the ES brought to the organization and the survey to both project leader and users will give a picture of the difference between the expected value and the actual result from the system. Although differ-
ent data collection techniques were deployed, the analysis technique will not be mixed. Details about data collection and analysis will be elaborated in the following chapters.

2.5 Data collection

Data collection is the crucial part in a research as the whole analysis will be based on the data collected. To ensure the credibility of the research, it is important to decide the way to get the most useful data and ensure data accuracy. Data collection technique is decided according to the nature of research questions. As for this research, both primary and secondary data are needed. The data source and data collection technique will be specified in the following section.

2.5.1 Primary data

2.5.1.1 Interview

Interviews can be classified as structured interview (standard interview), semi-structured interview and unstructured interview (in-depth interview). The goal of doing interviews is mainly to answer the first research question and qualitative data are desired from the interview, structured interview is not in the consideration as it is better used in descriptive studies or to be used in a statistical sense (Saunders, Lewis & Thornhill, 2007, p314). Robson (2002) suggested that in-depth interviews can be very helpful in an exploratory study, and semi-structured interviews may be used in order to understand the relationship between variables (Saunders, Lewis & Thornhill, 2007, p313). Based on this argument and the research purpose, the interview is organized in a semi-structured way in this paper, as it allows freedom for interviewees to talk about related issues in the project and ensures the conversation is going to the right direction at the same time.

In order to avoid the errors and bias suggested in Saunders et al, certain measures were deployed. The interviews were conducted with CIO and project leaders in a face-to-face manner. In order to ensure the reliability, a presentation of the XROS project was sent from the organization to give a brief introduction of the project before the interview, so that the interviewer can have a general understanding about the context. A well-defined question list for the interview will be double-checked and then sent to the interviewee at least one day before the interview, so that the interviewee can have time to prepare for the interview. Because open-ended questions were the main type of question on the list, it was difficult to note all the important information and thus, electronic records were kept with the permission of the interviewee in order to better analyze the information from the interview. The location of interviews is in the conference room in the Jönköping County Council where is convenient for both interviewer and interviewees. The questions are written in plain language, long sentences, jargon and slangs are avoided in order to reduce the risk of misunderstanding and during the interview, the interviewees are free to ask questions if they have any doubts. E-mails are used to contact the organization and send documents. Interviewees in the Jönköping County Council were willing to provide help and until now, four interviews were conducted. Questions are defined according to the theoretical framework, the context of the project and the research questions; the Internet is also an addi-
tional source of questions. By doing this, the questions were enriched and assured to meet the research purpose.

2.5.1.2 Survey

Surveys are conducted by sending questionnaires in order to collect quantitative data. Internet-mediated questionnaire was chosen, one of the reasons is that it is the request of the organization, and on the other hand, the sample size, which is 500 out of 8000, is large and self-administrated questionnaire like Internet-mediated questionnaire is suitable in this circumstance. The aim of using questionnaire is to compare the expected and actual results from the system. There were two versions of the questionnaire, one for end users and the other one for the project leader in IT center. The main difference between these two versions was that in the user questionnaire few IT professional vocabularies were used while the other questionnaire was more professional with IT vocabularies. The reason behind this can be considered as they have different knowledge context and different views of the system, thus it is the measure to avoid bias and errors.

As suggested by Saunders et al, one way to ensure that essential data are not missed is to develop a data requirements table. Documents from the Jönköping County Council supported the development of such tables. The questionnaire was then developed with the help of the table. To describe it with details, the table was consisted with categorized system effects and the corresponding performance indicators were developed to measure the strength of the effect. Pilot test was done in three days by sending the questionnaire to few people including the project leaders in the Jönköping County Council. According to the Pilot test, questions were developed within a natural and easy-to-understand way. The language is also refined to decrease the chance of misunderstanding. Discussions about the questionnaire were conducted during the interview and most suggestions were about the language problem because the questionnaire was translated from English to Swedish. What’s more, the pilot test also ensured the validity of data collected. Descriptions were added to help the respondents understand the questions and most suggestions, especially the ones from the project leaders, were taken to modify the questionnaire.

It is impossible to collect data from the whole population which is all the users of the XROS project in Jönköping County Council, so selecting a proper sample is crucial for generalizability. According to the project leader, there are around 8000 users of the system. As suggested by Saunders et al, sampling techniques can be specified as probability samples and non-probability samples. Take the context of the organization into consideration; the technique chosen for this article is cluster sample from non-probability sample techniques. Henry (1990) suggested that researchers need to divide the population into discrete groups to sampling in cluster sampling (cited in Saunders, Lewis & Thornhill, 2007, P223). The clusters in this form of sampling can be based on any naturally occurring grouping (Saunders, Lewis & Thornhill, 2007, P223). In this case, the clusters were specified as the department in the health care. The next step of cluster sampling is choosing a few clusters randomly and the samples are chosen from these clusters. With the help of the project leaders in the Jönköping County Council, this work is done smoothly and there were fifteen days, which is from 25th April to 10th May, to collect data. Departments with more users were
chosen as clusters by the project manager and the total sample size is 500 out of 8,000 users in the Jönköping County Council. According to Saunders et al, the response rate of self-administrated questionnaire is relatively low; however, there are 401 respondents in this case. The reason behind this phenomenon was partly due to the help of the managers from the Jönköping County Council.

2.5.2 Secondary data

Secondary data refers to the data that have been collected for some other purposes (Saunders, Lewis & Thornhill, 2007, P245). The types of secondary data are specified in to three types, documentary, multiple source and survey. As for this research, documentary secondary data are adopted, which include organizational reports from the CIO and the project leaders, books, journals and so on. The main sources used to locate secondary data are the Internet and the library, since the managers in the organization were willing to provide help, access to organizational documents were ensured.

2.5.2.1 Evaluation of secondary data

Compare to primary data, secondary data were easier to collect. However, secondary data must be viewed with the same caution as any primary data that researchers collect (Saunders, Lewis & Thornhill, 2007, P263). Key words, which will be summarized in the following section, were used when searching literatures. The main search engine was Google Scholar and the authorities of articles from the Internet will be double-checked to ensure the reliability. Reference list from books and articles were found useful when searching relative information and filtering irrelevant references. On the other hand, documents from the organization are relatively harder to evaluate because it was more difficult to trace back how the documents were documented and due to the language problem, there might be misunderstandings about the documents. In order to ensure the reliability and validity of the documents, the work of arranging documents were done after the interview, and if questions were found, e-mails would be sent to the project managers and when it was possible, discussions about the documents were conducted during the interview in order to avoid observer errors and bias.

Table 2.6.2.1-1 Key words are used to search for literatures

<table>
<thead>
<tr>
<th>Key words</th>
<th>Key words</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enterprise system</td>
<td>ERP system</td>
</tr>
<tr>
<td>Health care</td>
<td>IS in health care</td>
</tr>
<tr>
<td>Post-implementation</td>
<td>ES post implementation</td>
</tr>
<tr>
<td>ERP in health care</td>
<td>Jönköping County Council</td>
</tr>
<tr>
<td>ERP post-implementation in health care</td>
<td>ES affect organization</td>
</tr>
<tr>
<td>ES lead to organizational change</td>
<td>Training during post-implementation</td>
</tr>
<tr>
<td>ES evaluation</td>
<td>System evaluation during post implementation</td>
</tr>
<tr>
<td>Post implementation phase in IT project</td>
<td>Evaluation during post implementation</td>
</tr>
<tr>
<td>Swedish health care</td>
<td>Process in health care</td>
</tr>
<tr>
<td>System characteristic</td>
<td>Organization characteristic</td>
</tr>
</tbody>
</table>
3 Frame of reference

This chapter presents a review of existing literature on introduction of enterprise system, enterprise system implementation life-cycle and enterprise system effects evaluation method. There are some main discussions that focus on system effects evaluation model within the post-implementation phase to explore the relationship between system effects and business process. A guideline of use of evaluation method is present as well. These theories construct a guideline to develop a conceptual and theoretical framework to guide and analyze empirical findings.

3.1 Enterprise System

“Enterprise Systems are comprehensive software applications that integrated various functionalities and support critical organizational functions in order to achieve the organization’s goal of enhanced effectiveness and efficiency in their business processes.” (Motiwalla & Thompson, 2009)

It is important to understand what Enterprise System (ES) is and how ES works in an organization before deeply discussing the implementation issues. In 1998, Davenport defines that ES as a commodity, commercial software packages, seamlessly integrate all information flowing through an organization. Klaus et al. (2000) argues that ES can also be a key role in an organization, which supports business process and delivers IT solutions to business process. O’Leary (2005) adds that the goal of ES is to advance existing integrated and real-time planning, production and customer support. As shown in figure 3.1.1-1, Motiwalla et al. (2009) state that the ES integrate various functionalities of the organization as well as the system is “web-enable” or “online-based” which means that the system enables all of the organization’s employees, clients, partners, and vendors access to the system from anytime and anyplace by using web client.

![Diagram of Integrated System - Enterprise System](Image)

**Figure 3.1.1-1** Integrated system – Enterprise System

*(Adapted from: Motiwalla & Thompson, 2009, Enterprise System for Management, p8)*
In order to facilitate the information flow between enterprise functions within the boundaries of the organization and control the connections to outside stakeholders (Bidgoli & Hossein, 2004), the key ES components are defined to assist and ensure the information delivery. Thus, as shown in figure 3.1.1-2, hardware (i.e. servers and peripherals), software (i.e. operational system), database, organization process (i.e. business process, procedures, and policies) and people (i.e. end users and IT staff) are the five system components which can convert data into useful information for all the organization users. As the combination of these components is used during the ES implementation, all the components should be evaluated carefully and work together seamlessly (Uwizeyemungu et al., 2009). In other words, the five components are integrated and layered appropriately to support each other. The purpose of the collaboration is to achieve the organization’s goal of enhanced effectiveness and efficiency in their business processes (Moticalla & Thompson, 2009).

![Figure 3.1.1-2 integration of Enterprise system components](Adapted from: Motiwalla & Thompson, 2009, Enterprise System for Management, p13)

As an enterprise-wide system, enterprise system integrates different modules which have different functionality (Stein et al., 2003). Each module fits a major functional area of an organization. For instance, there are some common modules for business organization, such as finance, human resources, manufacturing and accounting. Different type of organization depends on their own organizational functionality to choose appropriate modules to integrate with their enterprise system (Berg, 2001). For healthcare enterprise system, some special modules are needed to fulfill health care organization functionality, such as clinical physiology and laboratory documentation (McKee et al., 2008). In general, if organizations select greater the number of modules, the greater the integration benefits they will get. However, as the number of modules is increased, the level of expenses, risks and changes will be enlarged as well (Zairi et al., 2000).
3.2 Enterprise System Implementation life-cycle

“Enterprise system implementation is a complex organizational activity.” (Motiwalla & Thompson, 2009)

As Motiwalla (2009) states that implementing an ES is complex, time consuming and resource intensive, it is important to deeply understand and carefully plan the implementation life cycle. Because ES implementation is not a short-time implementation, it requires a continuous life-cycle to release and support. As figure 3.2-1 presents an overview of the ES implementation life-cycle, there are three crucial phases of ES implementation life-cycle, pre-implementation, implementation and post-implementation (Herold et al., 1995). Mostly, pre-implementation and implementation are learnt as a combination in many researches (Motiwalla & Thompson, 2009; Dong et al, 2002; Markus et al., 2000). Relatively, the post-implementation phase also called operation phase is researched individually. (Nicolaou, 2004)

![Figure 3.2-1 Enterprise Implementation Life Cycle](Adapted from: Al-Mudimigh et al., 2001 & Motiwalla & Thompson, 2009)

3.2.1 Pre-implementation & Implementation Phase

The pre-implementation phase and implementation phase are complicated and thorny tasks. To implement an enterprise system should concern about all kinds of organization factors. Changes are unavoidable during this period. The Enterprise System brings IT effects and affects business processes in an organization unquestionably (Al-Mudimigh et al., 2001). To successfully implementing an ES, it is important to analyze the current organization structure and process. The figure3.2.1-1 shows that the organization should build the defi-
nition of organizational requirements and analyze the gap. Corbin (2006) stated that building business case and analyzing the current legacy system are essential steps that can effectively lead the implementation to success. Meanwhile, it is also necessary to select software vendor and hire consultant prudently. For many organizations, system customization is the most important thing when they communicate with software vendors. Because different type of organization has different working processes and needs, the outcome of customization is very changeful. For instance, in healthcare organization, the standards of customization are more special and changeful than business organization (Baker et al., 2008).

In additional, to choose an appropriate implementation strategy is also a significant decision in the beginning of the implantation phase. To choose step-by-step strategy or big-bang strategy depends on organization requirements and actual situation. Many experienced consultant companies like to introduce their best practice to organizations in order to assure the success of system implementation. It is also a good way to help organizations through the complex period.

![Figure 3.2.1-1 Pre-implementation & implementation Phase](Source: Presto!Consultants Pty Ltd, 2003)

### 3.2.2 Post-implementation Phase

This paper addresses system effects evaluation issue in post-implementation phase of large complex health care system. Therefore, this section particularly presents a discussion about ES post-implementation phase.

Mandal and Gunasekaran (2003) states that post-implementation phase is critical for the adoption of an ES in an organization. As mentioned in the life-cycle model and shown in the life-cycle chart (figure 3.2-1), the post-implementation contains various actions to ensure the system work efficiently. Go-live is one of the most critical points in a project’s success (Motiwalla, 2006). Thus, substantial time and resources have been spending to achieve to this point. Therefore, it is important to provide effective management and maintenance to the daily system during the post-implementation phase. In this phase, there are
many new processes should be comprehended and communicated in order to achieve the benefits of the ES implementation fully (Motiwalla & Thompson, 2009).

After the enterprise system goes live, the organization will shift into stabilization status (Motiwalla & Thompson, 2009). This stabilization period provides opportunities to users getting familiar with the new system and new processes. Moreover, this period also make available to fix problems or bugs in the system. During the stabilization period, the technical department should ensure the back-ups are taken properly for the enterprise system components (i.e. hard ware and softer ware). New modules and major upgrades are successively integrated with the implemented ES in order to offer more supports to business process. For achieving the success of post-implementation, it is important to provide sufficient system maintenance and post-production support. Motiwalla and Thompson, (2009) also suggest that continuous training has significant contribution to support the daily working processes efficiently. As Nicolaou (2004) suggests that it is necessary to ensure the user learning and knowledge transferring among managers and users, continuous training obviously has been an essential part in the post-implementation phase.

For effectively managing the post-implementation phase, post-implementation review (PIR) is defined to assess and review the completed implementation outcomes. Because the key point of PIR is to evaluate the outcomes of ES implementation, it performs after a period of system go-live. One of the most important evaluation objects is System Effects, which means how system impacts on the business processes. The next section presents a deeply discussion on this evaluation issue.
3.3 Enterprise System Evaluation Model (ESEM)

As ES has adopted to manage the core operational and management processes of large organization for several years, measuring and evaluating the contribution of ES to business process (both local-level and organizational-level) in the post-implementation phase has been a foremost issue for both ES professional and research communities (Uwizeyemungu & Raymond, 2009).

In 2000, Sircar et al. state that Causal models, as know as Variance models (Shin, 2006; Hendricks et al., 2007), which contribute to build a cause-effect relationship between IT investments and business processes. Meanwhile, Bergeon et al. (2000) present Contingency models which deduce that the impacts of IT to business processes depend on the IT strategy alignment and other factors. Moreover, Scorecard models (Wright et al., 1999) present more comprehensive performance indicators and uses to evaluate the effects of ES particularly (Rosemann & Wiese, 1999; Chand et al. 2005). In addition, Mooney et al. (1996) and Wieder et al. (2006) suggest Process models that evaluate the contribution of IT effects to business process. The process model can convert IT potential value into achievable value which contributes to the business process in an organization (Davern & Kauffman, 2000). Finally, Uwizeyemungu et al. (2009) present a more comprehensive model that specially evaluates the ES effects to business process:

“The Enterprise System Evaluation Model (ESEM) can be regrouped under four categories: causal model, contingency model, process model and scorecard model.” (Uwizeyemungu et al., 2009)

![Figure 3.3-1 Evaluation Model of Enterprise System Effects (ESEM)](Adapted from: Uwizeyemungu & Raymond, 2009, Exploring an alternative method of evaluating the effects of ERP, P252)
As shown in the figure 3.3-1, the Enterprise System Evaluation Model (ESEM) consists of four aspects: **Characteristics of ES implemented, Business processes affected by the Enterprise System, System effects, and Process and sub-process performance indicators.** The ESEM combines all the features of four evaluation approaches as mentioned above. Particularly, it extracts the core of Mooney’s process model, in other words, the **automational, informational and transformational effects** of system. These system effects influence both **operational and managerial processes** which construct the business processes in an organization (Mooney et al., 1996).

For explaining the usability of the model, Uwizeyemungu and Raymond (2009) explain that the ES evaluation method proposed is composed of **seven steps** which are described and illustrated in Appendix 5. These seven steps build a **process-based** method that is not only relates the relationship between effects of ES and affected business processes, but also addresses the Performance Indicators (PIs) in operational & management-level. Therefore, it is necessary to understand the implemented ES characteristics and analyze current business processes initially in order to accurately and effectively evaluate the implemented ES.

### 3.3.1 ESEM - Understand the implemented ES Characteristics

For exploring an implemented ES in an organization, the characteristics of the system should be understood initially. Generally, comparing with non-ES system, the Enterprise Systems typically are equipped with following characteristics:

| Table 3.3.1-1 Typical Characteristics of Enterprise System (Motiwalla & Thompson, 2009) |
|-------------------------------------------------|--------------------------------------------------|
| **ES Characteristics** | **Description** |
| Integration | • The ES Integrates the majority of the business processes seamless.  
• A consistent look and feel throughout each module |
| Module support | • There are different kinds of modules with corresponding functions to support the ES and doing daily transaction. |
| Data warehouse | • Repository for information  
• The ES uses data warehouse store data which support all applications and modules.  
• Sound database management manages and protects all the data in order to eliminate data redundancy. |
| Automation | • ES can automatically process major transactions and planning activities |
| Real-time data | • ES allows user to access to data in “real-time” which means that the data is up-to-date in real-time, not relying on periodic updates. |
| Networking | • The ES based on networking and online support in order to provide real time data and information interchange. |

These characteristics shown in the table are the fundamental characteristics of ES. However, different organizations have different business processes; thus, organizations in the real world need more functional system to support their daily business activities in order to gain more benefits. As mentioned in the ES implementation life-cycle, the system customization
as a solution endows the modified ES with diverse characteristics. Therefore, the customized ES is equipped with fundamental characteristics while combined with characteristics of organizational business process on the other hand. By understanding the organizational ES characteristics, the seven steps of evaluation method can be conducted more smoothly (Uwizeyemungu et al., 2009).

3.3.2 ESEM – Affected business processes

3.3.2.1 Business processes analysis

The first two steps of the evaluation method address the business processes analysis to find out which processes are affected by ES. Uwizeyemung et al. (2009) suggest that the business process of the target organization should be analyzed on one hand; the way of analysis can be based on Mooney’s Business process typology (Mooney et al., 1996) on the other.

![Business Processes Typology](image)

**Figure 3.3.2.1-1 Business processes typology**

(Source from Mooney et al., 1996, A Process Oriented Framework for Assessing the Business Value of Information Technology, P72)

As shown in the Figure3.3.2-1, business processes consists of operational processes and management processes. Mooney et al. (1996) states that IT is used to support both operational and management processes in order to produce IT business value.

On one hand, the key issue is to recognize the role of IT which interacts with organization daily activities. The operational processes present the fundamental working processes which directly affected by IT (Uwizeyemung et al., 2009).

On the other hand, the management processes refer to the administration, control and communication that are performed by managers or the management level of organizations.
3.3.2.2 System Effects Impacts On Business Processes

Mooney et al. (1996) present an Enterprise System effects framework to help organizations categorize system effects in order to evaluate the contribution of IT more effectively. The following two steps of system evaluation method comply with Mooney’s viewpoint and strengthen it. In addition, Uwizeyemungu et al. (2009) point out that the system effects are the object of study which means that these effects should be obtained based on research and exploration. According to Mooney’s process model (1996), these system effects should be identified and categorized to automational, informational and transformational effects. The Automational effects improve the efficiency of labor costs, automated processes. The Informational effects advance the information flow, which increase the value from collecting, sorting, processing and forming information (Aro, 2005). Therefore, the decision making, effectiveness or some business processes are improved. The Transformational effects stand for the increase of process innovation and business re-engineering, which are produced by IT. As shown in the figure 3.3.2.2-1, the enterprise system affects both of two business processes and produces automational, informational and transformational effects (Mooney, Gurbaxani & Kraemer, 1995).

<table>
<thead>
<tr>
<th>Business Processes</th>
<th>Automational</th>
<th>Informational</th>
<th>Transformational</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operational</td>
<td>Labor costs</td>
<td>Utilization</td>
<td>Product and service innovation</td>
</tr>
<tr>
<td></td>
<td>Reliability</td>
<td>Wastage</td>
<td>Cycle times</td>
</tr>
<tr>
<td></td>
<td>Throughput</td>
<td>Operational flexibility</td>
<td>Customer relationships</td>
</tr>
<tr>
<td></td>
<td>Inventory costs</td>
<td>Responsiveness</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Efficiency</td>
<td>Quality</td>
<td></td>
</tr>
<tr>
<td>Management</td>
<td>Administrative expense</td>
<td>Effectiveness</td>
<td>Competitive flexibility</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>Decision quality</td>
<td>Competitive capability</td>
</tr>
<tr>
<td></td>
<td>Reporting</td>
<td>Resource usage</td>
<td>Organizational form</td>
</tr>
<tr>
<td></td>
<td>Routinization</td>
<td>Empowerment</td>
<td></td>
</tr>
</tbody>
</table>

Figure 3.3.2.2-1 System Effects framework
(Source from Mooney et al., 1996, A Process Oriented Framework for Assessing the Business Value of Information Technology, P78)

The framework names different processes for both operational and management processes which are affected by ES implemented and categorized to three kinds of system effects dimensions. Because Uwizeyemungu et al. (2009) stress that the affected business process should be obtained from the organization rather than defined by researchers, the affected business processes and sub-processes are perceived by managers and users in the target organization. It is very useful to understand and identify affected business processes in order to evaluate the contribution of ES accurately.
3.3.3 ESEM - Identify performance indicators (PIs)

3.3.3.1 Build relationship between affected business process and PIs

The ESEM is not only to extract the core of Mooney’s framework, but also stresses the concepts of Performance Indicators (PIs). The affected business processes should build relationship with corresponding performance indicators.

Wright et al. (1999) states that PIs translate the affected business processes into to quantitative value. It means such PIs can be measured and graded (Uwizeyemungu et al. 2009). In the seven steps of evaluation method, the PIs play a great role, because identified PIs will be determined their importance (from 1: unimportant to 5: very important). The process of determination can help the organization explore and evaluate the direct & indirect system effects and realized & unrealized effects. Additionally, ESEM addresses the system effects impact on business process during the post-implementation phase comprehensively (Uwizeyemungu et al., 2009). It is not only used to explore the system effects, the results also can be used to compare the expected value with actuality. However, only build the connection between processes and PIs is not enough to evaluate the system effects, thus, the following step is to establish the correspondence between the enterprise system effects and various performance indicators suitably in order to evaluate the system effects accurately.

3.3.3.2 Build relationship between System Effects and PIs

Raymond (2009) states that many organizations only know the existence of PIs is important, but to what extend the system affects these PIs. Therefore, it is necessary to establish the correspondence between the ERP effects realized and the various performance indicators (Uwizeyemungu & Raymond, 2009). Further on, Uwizeyemungu (2009) suggests that it is required to determine the degree of such effects by given values (no impact: 0, weak impact: 1, medium impact: 2, strong impact: 3).

3.3.3.3 Final calculation of results

In the final step of the evaluation method, to use formulas to calculate the value of importance and impacts is extremely crucial approach. Uwizeyemungu et al. (2009) presents an algorithm to calculate the value of system effects as following:

\[
\text{Sum1: } \sum_{i=1}^{n} (a_i \times b_i) \\
\text{Sum2: } \sum_{i=1}^{n} (a_i \times c)
\]

For explaining these formulas, Uwizeyemungu et al. (2009) elucidate that \(a\) stands for the importance of PIs (1-5) which are determined by managers, \(b\) stands for the degree of the PI’s variation induced by the ES effect (0 to 3) which are determined by users. \(C\) is the constant (if \(b_i \geq 0, c = 3\)), which means the maximal value of the degree of system impacts. Sum1 of \((a \times b)\) stands for the actual results of system effects. The Sum2 \((a \times c)\) stands for the full score of system effects (perfect value).
To transpose the sum of \((a \times b)\) to more meaningful number such as 1 (very weak) or 5 (very strong), it needs other formula to achieve it:

\[
\text{Score} = 5 \times \frac{\text{Sum1}}{\text{Sum2}}
\]

This kind of algorithm is very useful and intuitional for transposing data between quantitative value and qualitative value in order to achieve the objective of system evaluation. The practice of the algorithm will be present in the analysis section.
4 Empirical data

Data are crucial for analysis. As the raw data are disordered and some data are not useful for the thesis, the arrangement has to be done for further analysis. The following section will represent the useful data about the organization, the ROS system, the interview and the survey result.

4.1 Jönköping County Council

The Jönköping County Council is a democratic organization aiming at providing health and medical care and dental care to inhabitants in Jönköping County. The CIO of Jönköping County Council introduced that the services should be equal to all, easily accessible and the quality of the treatment should be ensured. There are 336,481 inhabitants in the County so it is necessary for them to have an effective and efficient system to help them with their daily work.

4.1.1 IT center in Jönköping County Council

According to the interview of CIO of IT center (ITC) of Jönköping County Council, the mission of this department is to create value to its customers which includes employees in the Jönköping County Council and inhabitants by delivering quality IT service. ITC is a centralized department where CIO takes the decisions and directs everyone. The main process areas of ITC are customer support, project and system management and installation and operation. ITC contributes to the whole Jönköping County Council by delivering appropriate IT solutions to daily operations.

4.2 The ES implemented by Jönköping County Council

4.2.1 The motivation of adopt an Enterprise System

The major IT environment in Jönköping County Council is very large and complex. As shown in the Appendix 1, there is three main Enterprise Systems (Cosmic, Journalportal and ROS) and several modules build the major Jönköping County Council’s IT environment. The integration and interaction among such ESs are supporting Jönköping County Council’s daily work processes for health care.

ROS system is the youngest of them, which has been implemented in 2007 and now it is in the post-implementation phase. Before the introduction of ROS system, the Jönköping County Council was working in a traditional way. Doctors used forms to order analysis. The form would be sent to the laboratory and the results would be printed on a sticker. Then the doctors needed to take off the sticker and put it on the form. It was difficult to match the results with the right cells because it was done manually. What’s more, since there were no history records for the results, it was impossible to trace back the analysis. So it was easy to make mistakes and lose patient information with this kind of working process.

Therefore, the Jönköping County Council decided to adopt an enterprise system in order to change the time-consuming and ineffective work process. There is a range of factors that motivated Jönköping County Council’s decision to replace its insufficient work process by an Enterprise System are presented in Table 4.2.1-1, with the importance level
which are defined by Jönköping County Council’s management. According to Raymod, Uwizeyemungu and Bergeron’s view, such motivations are categorized to technical, operational, strategic and performance-related. By keeping with these pre-dominated demands, ROS system is designed and implemented to realize these objectives.

Table 4.2.1-1 *Motivations and Importance for ROS system adoption*

<table>
<thead>
<tr>
<th>Motivations for ROS system adoption</th>
<th>Importance$^a$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Technical</strong></td>
<td></td>
</tr>
<tr>
<td>- Integrated IT environment</td>
<td>5</td>
</tr>
<tr>
<td>- More functions support</td>
<td>4</td>
</tr>
<tr>
<td>- More secure data management</td>
<td>5</td>
</tr>
<tr>
<td><strong>Operational</strong></td>
<td></td>
</tr>
<tr>
<td>- Improve the physiology clinic work processes</td>
<td>5</td>
</tr>
<tr>
<td>- Improve the Lab medicine clinic work processes</td>
<td>5</td>
</tr>
<tr>
<td>- Improve the radiology work process</td>
<td>5</td>
</tr>
<tr>
<td>- Access to reliable information</td>
<td>5</td>
</tr>
<tr>
<td><strong>Strategic</strong></td>
<td></td>
</tr>
<tr>
<td>- Improve Jönköping County Council’s competitive advantages</td>
<td>4</td>
</tr>
<tr>
<td>- Build integrated health care system in the whole Europe</td>
<td>4</td>
</tr>
<tr>
<td><strong>Performance</strong></td>
<td></td>
</tr>
<tr>
<td>- Improve customer satisfaction</td>
<td>5</td>
</tr>
<tr>
<td>- Improve the efficiency of corresponding work processes</td>
<td>5</td>
</tr>
</tbody>
</table>

$^a$Importance of the motivation on a scale of 1 (unimportant) to 5 (very important).

*(Summarized from the interview by authors, 2011)*

4.2.2 XROS project started

XROS is the name of ROS system implementation project in the Jönköping County Council, which aims to provide an integrated system for users to handle patients’ information in their daily work.

Agnetha Södergård, the project leader who was working in the consulting group in the IT center, introduced the XROS during the interview. The project team was consisted with 25 people and there was an external consulting time of 3020 hours. ROS system is designed to a supplement of the lab medicine system (legacy system), LabRos, with the range of radiology and clinic physiology. Meanwhile, Östergötland County Council takes the same decision of implementing the new system, and thus the project was conducted as a collaborative project between the County Councils. Based on this, a crucial task in the project was to coordinate the requirements with external providers.

The ROS system could be viewed either as a module integrated in the Cosmic system or an independent enterprise system, as the system can be used independently on any computer. The two modules integrated in the ROS system are radiology and physiology. Since the project was conducting with Östergötland County Council, the ROS system also integrated
the LIO’s old system which was provided by PafWeb and the data can be shared between the two County Councils (see Appendix1).

The system was first built in-house as LabRos and then sold to the system provider EDB for further development. EDB changed the name of the system into ROS and helped the County Council implement the project. The project was supposed to be finished in three years; however, it was delayed because there were some problems with the radiology software vendor Agfa. Agfa was experiencing a re-structure in the company and the radiology technology was not ready at that time. This part of the project is still in development and the organization is adopting a ‘build in maintenance’ strategy. The clinical physiology is tested and delivered on time. According to Agnetha’s viewpoint, the system works well and was highly remarked among users. This system changes the way people working and improved the efficiency significantly.

The implementation strategy adopted by the system was “parallel strategy” as known as “step by step strategy”. The LabRos was used in parallel with Ros and was taken place by Ros step by step. Until now, the LabRos was completely replaced by Ros and because of the experience of using LabRos, the employees got familiar with Ros fast and smoothly. The XRos project is now turned into training and maintenance phase and will be completed in June, 2011.

Table4.2.2-1 summarized XROS project

<table>
<thead>
<tr>
<th>Description</th>
<th>Year of the project start</th>
<th>Year of the project finish</th>
<th>ES Adopted</th>
<th>System provider</th>
<th>Project manager</th>
<th>Project team</th>
<th>External intervention in the implementation process</th>
<th>Implementation duration</th>
<th>Basis of the system selection</th>
<th>Implementation strategy</th>
<th>Main modules</th>
<th>Elements kept from the legacy system</th>
</tr>
</thead>
<tbody>
<tr>
<td>ES implementation</td>
<td>2007</td>
<td>June 2011</td>
<td>ROS system</td>
<td>EDB</td>
<td>Agnetha Södergård</td>
<td>25 people</td>
<td>External consultant, 3020 hours</td>
<td>3 years</td>
<td>develop the functionality of LabRos</td>
<td>parallel strategy</td>
<td>Clinical physiology, Radiology</td>
<td>LabRos system</td>
</tr>
</tbody>
</table>

4.2.3 ROS system changed business processes

As shown in Figure 4.2.3-1, ROS system brings doctors a series of totally new working processes. Paper work was taken place by ROS in the organization and the whole work process is monitored and recorded by the system. The project was conducted along with Östergötland County Council, so it was important to design an integrated system that could handle patients’ information in both County Councils. From the doctor’s view, Agnetha,
the project leader said during the interview, “The order will show the personal number and know all the information. It shows all the function like analysis. A new thing for ordering is configuration with other department. You can choose your package or you can open each one on the system. The new technology is to combine the radiology and clinical physiology together. The system looks simple but it isn’t, because information will go down to servers and go down to different department who have the patient.” The records of analysis are kept so that doctors can track the results of the analysis to decrease the mistakes. Data can be accessed at anyplace from any computer and applications can be integrated into the system.

Before the ROS system, the Jönköping County Council was using several different systems for different functions. Data could not be shared among these systems so users needed to login several times when shifting between the systems. So integrating the systems into one system was the main aim of developing ROS. The first pilot test for ROS system was in 2003, and when talking about the future plans, Agnetha said, “When you finish the project in the future, the new technology will come and make the current system old. Now we think the Ros system can do everything for the health care. We have to think the future but it is too complicated”. There are instructions for both scheduled and non-scheduled system downtime to make sure that data will not be lost. Security measures like backup solutions are also taken to ensure data security. Agnetha states that “As the County Council is a health care organization, it is very important to protect patient’s personal information safe and accurate. Documentary is another important aspect of the system.” The project leader thinks that well categorized data will be easy to trace and keep.

Figure 4.2.3-1 new business process and Performance Indicators (PIs)
(Access from Interview and Internal documents and summarized by authors, 2011)
The implementation of ROS system also brings changes to the organization. Agnetha has to communicate with the employees and provides proper training and technical help after and during the implementation of the system. There was test version of the system. This test version system was used in the emergency department to collect reflection and the ROS system was then modified according to the reflection. Agnetha said that the pilot test of the system including evaluating “the layout, usability, information education, technique, and they are the information we need to get to implement the system in a good way” and a reference group was used to test the user acceptance and ensure the users “can find everything in the system and also how the project involved, how to order information in the Ros, how to do the test”. Yet the performance of the system is not well evaluated since the working processes were so different from the past, the project leader showed great interest on performance evaluation. Agnetha commented that “This system has created new work tasks; the ones in the old system have disappeared, so that is interesting to know if you have gained employees by implementing the new system.”

According to the interview and relative documents, the affected business processes are identified, which are categorized by three system effects dimensions in following:

Table 4.2.3-1 Categorized system effects (SEs) affect business processes (BPs)

<table>
<thead>
<tr>
<th>SEs</th>
<th>Automational Effects</th>
<th>Informational Effects</th>
<th>Transformational Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>BPs</td>
<td>Operational process</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Building more stable system</td>
<td>• Precision and accuracy of data</td>
<td>• Customer relationship</td>
</tr>
<tr>
<td></td>
<td>• Elimination of redundancies</td>
<td>• Improvement in system responsiveness</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Providing easier work process</td>
<td>• Compatibility of the entire IT infrastructure</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• User-friendly interface</td>
<td>• Improvements in decision making</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Integration of resources</td>
<td>• Improvement in resource usage</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Improvement in order control</td>
<td>• Improvement in data security</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Better management and monitoring tasks</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
4.3 Determine the Degree of System Impacts

4.3.1 Determined by Users

According to the XROS system documents, some PIs are already identified (Appendix3).

The following questions in the survey were designed based on the affected businesses processes, which included all the aspects that were important to the project leader. The aim of the questionnaire was to investigate in users’ attitudes toward ROS. There were 401 respondents in total, most of them came from nurses, doctors, healthcare administrators and midwives. Female respondents are much more than male. The ages are dispersed from 30 to 60. Most of the questions are rating questions and the choices range from 1 (strongly disagree) to 5 (strongly agree).

**Question 1 ROS system is easy to use**

There were 219 respondents out of 398 chose agree and 78 chose strongly agree on this question. The mean value is 3.82, which is nearly 4. This result shows that most employees think they can use the system in an easy way.

**Question 2 it is easy to remember how to use the system after I learned.**

There were 401 respondents answered this question, 225 of them chose agree and 103 chose strongly agree. The mean value of this question is 4.01, most respondents think the system is easy to remember once learned.

**Question 3 if the ROS system is not mandatory to use, I would still use it.**

This question aims at testing the loyalty of the respondents to ROS system. If the system is successful, users will stick to it even if it is not mandatory to use. The result of this question is 160 out of 387 respondents chose agree and 119 chose strongly agree. The mean value is 3.95, most users like to use the system.

**Question 4 the interface of ROS system is user friendly.**

As for this question, 164 out of 401 respondents chose agree and 56 respondents chose strongly agree. The mean value is 3.59, which is lower than the previous questions but more than half respondents think the interface is user friendly.

**Question 5 the information from the system is correct.**

This question tested the information accuracy of the system. As a result, 184 out of 395 respondents agree on this question and 105 respondents chose strongly agree. The mean value is 3.97, the information of the system is accurate but still, there is space to improve.

**Question 6 the information of the ROS system is valid.**

There were 397 valid answers to this question, 190 of them chose agree and 59 of them chose strongly agree. The mean value of this question is 3.66, which means there is invalid information in the system, but does not affect the system too much.

**Question 7 ROS system displays up-to-date information.**

There were 397 respondents answered this question. 197 of them chose agree and 116 chose strongly agree. The mean value is 4.05 so it can be inferred that the information in the system is up-to-date.

**Question 8 when I use the ROS system, I can find the information I need quickly.**
This question is used to investigate in the usability of the system. There were 163 out of 391 respondents chose agree and 91 respondents chose strongly agree. The mean value is 3.73. According to the result, it can be inferred that the system generally achieves the usability goals.

**Question 9** although I am not in the office, I have access to my patients’ information via ROS system.

Information accessibility is tested in this question. There were 383 respondents answered this question. 97 of them chose agree and 92 chose strongly agree. The mean value is 3.42, which is relatively low.

**Question 10** using the ROS system, I can diagnose my patient properly.

This question aims at investigating how much help the system can offer to the daily work. There were 366 valid answers and 99 of them chose agree, 34 of them chose strongly agree. The mean value is 3.35 so the ROS system helps to diagnose the patients in a limited way.

**Question 11** using the ROS system, I can diagnose my patients on time.

The number of total respondents is 360 and 98 of them chose agree and 31 chose strongly agree. The mean value is 3.34, which means that the system does little help to doctors on scheduling.

**Question 12** using the system, it is more convenient to communicate with patients.

As one of the goals of the information system is communication, this question tested the communication between doctors and patients. There were 368 answers and 99 of which chose agree and 34 chose strongly agree. The mean value is 3.21, so this system does not improve the level of communication between doctors and patients much.

**Question 13** ROS system can protect patients’ privacy.

This question investigated in data security aspect of the system. In the total 372 valid answers, 90 respondents chose agree and 22 chose strongly agree. The mean value is 3.21, it can be inferred that the system should be improved to protect the patients’ data.

**Question 14** ROS system ensures patients’ safety significantly.

There were 145 out of 382 respondents chose agree and 33 respondents chose strongly agree. The mean value of this question is 3.48, so ROS system has little things to do with protect patients’ safety.

**Question 15** ROS system significantly reduces the patient waiting time for results.

This question tested if the system could increase the efficiency of analyzing processes. There were 154 respondents out of 381 chose agree and 58 of them chose strongly agree on this question. The mean value is 3.62, which means the system improved the efficiency in some way.

**Question 16** ROS system makes it possible for me to get information from other systems.
This question investigated in the data sharing between ROS and other systems. The result shows 373 respondents answered this question. There were 102 respondents chose agree and 26 respondents chose strongly agree. The mean value is 3.18, so it can be inferred that users do not feel much about data sharing between the systems.

**Question 17 until now, I never lose data by using the ROS system.**

This question concerned about data security in data losing aspect. There were 381 respondents in total. 116 of them chose agree and 40 chose strongly agree. The mean value is 3.39. This result reveals that the system may lose data in some circumstances but it is not very serious.

**Question 18 ROS system helps me to categorize patients.**

There were 364 respondents answered this question. 85 of them chose agree and only 16 chose strongly agree. The mean value is 3.16. From this result, it can be seen that people have very neutral attitudes toward this aspect.

**Question 19 ROS system helps me to track patients’ information**

As the project leader said in the interview, the system keeps record so everything should be traced back. As for this question, 147 out of 373 respondents chose to agree and 28 of them chose strongly agree. The mean value is 3.42; about 50% respondents think the system helps to track the patients.

**Question 20 ROS system helps me to make decisions on time.**

As for this question, there were 361 valid answers. 122 of them chose agree and 23 chose strongly agree. The mean value is 3.37. The respondents do not have very clear attitudes toward this question.

**Question 21 ROS system helps me to make right decision.**

The total number of respondents of this question was 361, 133 of them chose agree and 17 of them tend to strongly agree. The mean value is 3.39. This result shows that the users do not think the system helps much on decision making process.

**Question 22 ROS system makes my job easier than before.**

This question investigated how well the system helps users in general. There were 384 respondents in total. 175 of them were agreed and 66 of them were strongly agreed. The mean value is 3.70, which indicates that most people think the system helps with their jobs.

**Question 23 I think I need more trainings to learn how to use the system.**
This question concerned about the training in the County Council. The total number of respondents to this question was 3.92; most of them thought they do not need more training (78.1%). This result indicates that the organization trained their employees well.

*Question 24 until now, I am happy with the system.*

As the system changed the way they working radically, it is important to know if the users are satisfied with the new processes. For this question, there were 397 respondents answered and 199 of them chose agree and 69 chose strongly agree. The mean value is 3.74, which shows that users tend to have positive attitudes towards the system.

To sum up, the users gave higher scores to questions related to the experiences of using the system, for example, the system interface, the usability of the system or the information it plays. However, when it comes to the questions concern about the effects the system brings or the compatibility of the system, respondents tend to have neutral attitudes. The mean values of those questions, such as question 12, question 13 and question 17, are below 3.5. On the other hand, for those questions that concern about the whole impression of the system, the scores disperse from 3.70 to 4.

From what is discussed, it can be concluded that users like to work with the system, but they have no idea if the system improved working efficiency and service quality. While the main purpose of developing the system was to build a network of healthcare throughout the Europe, the County Council still needs to work with the data sharing of the system.

**4.3.2 User suggestions**

Users also gave some suggestions about the ROS system, which is summarized below. The number in front refers to the identification of respondents.

2, 6, 13, 20, 22, 35, 75, 82, 85, 103, 111, 246, 317, 371, 374: Will probably be better when finally the radiologist gets there too.

7, 49, 54, 73, 191, 247: Since we are mainly working in the Cosmic now so it would be desirable that Rose was more integrated into Cosmic and that you could sign and read the test results directly in his signature basket in the Cosmic.

9, 160: Making patient identity more clearly, if you go from one program to another, that patient data should be included.

22, 26, 349: Possibility to enlarge the history box further to more easily see what you type, the font now becomes small with the small magnification options available today of the box. Looking forward to when we get into radiology in the system and avoid paper order and answers.

30, 37: The negative I see in my use of the ROS is that you have to manually exchange patient data.
A clearer interface is desirable when the question of to cancel orders come up. RoS system has improved communication between the lab and the department through the history is legible and that controlled affairs makes it easier to evaluate samples.

Abnormal / positive findings in microbiology should be highlighted in red as abnormal responses in clinical chemistry. Microbiology-samples are difficult to grasp at this stage (people need to click on each individual test to see results) and should be obtainable at a cumulative list, for example, all blood cultures were done on patients.

I am satisfied with the ROS system in my work.

If you are in and sign for test results, they did not end up in the 35 last used patients. This means that you cannot go back to something you were not sure if you have already acknowledged, cannot track my signature. It lacks, and I have heard that more lack.

Provide more training on the elements contained in ROS.

User suggestions were chosen to see what can be improved in ROS system. As what were listed, many users are waiting for the radiology part and are satisfied with the system. Complaints are more about system compatibility, the user interface (mainly the font size), and results showing from the analysis. Some users also complain about the data sharing and training problems.
5 Analysis

This section presents the results from the Empirical data and is supported by the theoretical framework. Furthermore, this section answers the research questions by combined with the main theoretical framework - Enterprise System Evaluation model.

Table 5-1 Summarized results of ROS system effects and their impact on corresponding performance indicator

<table>
<thead>
<tr>
<th>Enterprise System effects</th>
<th>Performance indicator (PI)</th>
<th>i</th>
<th>a</th>
<th>b</th>
<th>a*b</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automational effects</td>
<td>Building more stable system</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Support for market standards</td>
<td>1</td>
<td>4</td>
<td>3</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>• Reduction in number of work accidents</td>
<td>2</td>
<td>5</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>• Reduction in number of system errors</td>
<td>3</td>
<td>5</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>• Reduction in human errors</td>
<td>4</td>
<td>5</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>• Reduction in data loss</td>
<td>5</td>
<td>5</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>• Reduction in system shut-down</td>
<td>6</td>
<td>5</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>Elimination of redundancies</td>
<td>• Reduction in data redundancies</td>
<td>7</td>
<td>5</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>• Reduction in the operating costs</td>
<td>8</td>
<td>5</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>• Data documenting</td>
<td>9</td>
<td>5</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>• Data classification</td>
<td>10</td>
<td>5</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>• Reduction in response time of the system</td>
<td>11</td>
<td>5</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>Improvement in order control</td>
<td>• Ambiguity of responsibility</td>
<td>12</td>
<td>5</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>• Reduction in operating costs</td>
<td>13</td>
<td>5</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>• Data documenting</td>
<td>14</td>
<td>5</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>• Reduction in number of “click”</td>
<td>15</td>
<td>5</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>• Data classification</td>
<td>16</td>
<td>5</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>• Up-to-date information</td>
<td>17</td>
<td>5</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>• Data sharing</td>
<td>18</td>
<td>5</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>• Reduction in human errors</td>
<td>19</td>
<td>5</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>• Tracking information</td>
<td>20</td>
<td>5</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>• Multiple-functions</td>
<td>21</td>
<td>5</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>• Data validity</td>
<td>22</td>
<td>5</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>• Data integrity</td>
<td>23</td>
<td>5</td>
<td>3</td>
<td>15</td>
</tr>
</tbody>
</table>
Table 5.1 Continued

<table>
<thead>
<tr>
<th>Enterprise system effects</th>
<th>Performance indicator (PI)</th>
<th>$i$</th>
<th>$a$</th>
<th>$b$</th>
<th>$a^*b$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Providing easier work process</td>
<td></td>
<td>24</td>
<td>5</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>• Reduction in labor costs</td>
<td>25</td>
<td>5</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>• Tracking information</td>
<td>26</td>
<td>4</td>
<td>3</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>• Usability of applications</td>
<td>27</td>
<td>5</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>• Data sharing</td>
<td>28</td>
<td>5</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>• Reduction in wastage</td>
<td>29</td>
<td>5</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>• Data documenting</td>
<td>30</td>
<td>5</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>• Data classification</td>
<td>31</td>
<td>5</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>• Reduction in human errors</td>
<td>32</td>
<td>5</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>• Reduction in number of “click”</td>
<td>33</td>
<td>4</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>• Multiple functions</td>
<td>34</td>
<td>5</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>• Reduction in data loss</td>
<td>35</td>
<td>5</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>• Quality of Output information</td>
<td>36</td>
<td>5</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>• Data validity</td>
<td>37</td>
<td>5</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>• Usability of current functions</td>
<td>38</td>
<td>5</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>• Single Sign-On (SSO)</td>
<td>39</td>
<td>5</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>User-friendly interface</td>
<td>• Quality of Output information</td>
<td>40</td>
<td>5</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>• Tracking information</td>
<td>41</td>
<td>5</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>• Reduction in human errors</td>
<td>42</td>
<td>5</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>• Data documenting</td>
<td>43</td>
<td>5</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>• Data classification</td>
<td>44</td>
<td>5</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>• Reduction in number of “click”</td>
<td>45</td>
<td>4</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>• Multiple functions</td>
<td>46</td>
<td>5</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>Enterprise System effects</td>
<td>Performance indicator (PI)</td>
<td>$i$</td>
<td>$a$</td>
<td>$b$</td>
<td>$a*b$</td>
</tr>
<tr>
<td>------------------------------------------</td>
<td>----------------------------------</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-------</td>
</tr>
<tr>
<td>Better management and monitoring tasks</td>
<td>• Reduction in the operating costs</td>
<td>47</td>
<td>5</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>• Ambiguity of responsibility</td>
<td>48</td>
<td>5</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>• Data classification</td>
<td>49</td>
<td>5</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>• Reduction in human errors</td>
<td>50</td>
<td>5</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>• Tracking information</td>
<td>51</td>
<td>5</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>• User authority and using range</td>
<td>52</td>
<td>5</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>• Data sharing</td>
<td>53</td>
<td>5</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>• Reduction in number of work accidents</td>
<td>54</td>
<td>5</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>• Reduction in number of system errors</td>
<td>55</td>
<td>5</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>• Single Sign-On (SSO)</td>
<td>56</td>
<td>5</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>Integration of resources</td>
<td>• Data sharing</td>
<td>57</td>
<td>5</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>• Access to data at any time</td>
<td>58</td>
<td>5</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>• Multi-contexts support</td>
<td>59</td>
<td>5</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>• Single Sign-On (SSO)</td>
<td>60</td>
<td>5</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>• Up-to-date information</td>
<td>61</td>
<td>5</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>• Data integrity</td>
<td>62</td>
<td>5</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>• Data availability in the clinical physiology Module</td>
<td>63</td>
<td>5</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>• Data availability in lab medicine Clinical Module</td>
<td>64</td>
<td>5</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>• Tracking information</td>
<td>65</td>
<td>5</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>Informational effects</td>
<td>• Up-to-date information</td>
<td>66</td>
<td>5</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>• Data validity</td>
<td>67</td>
<td>5</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>• Reduction in human errors</td>
<td>68</td>
<td>5</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>• Data sharing</td>
<td>69</td>
<td>5</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>• Data integrity</td>
<td>70</td>
<td>5</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>Enterprise System effects</td>
<td>Performance indicator (PI)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------------------------</td>
<td>---------------------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>( PI ) affected</td>
<td>( i )</td>
<td>( a )</td>
<td>( b )</td>
<td>( a^*b )</td>
</tr>
<tr>
<td>Improvement in decision making</td>
<td>• Tracking information</td>
<td>71</td>
<td>5</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>• Reduction in patient waiting time</td>
<td>72</td>
<td>5</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>• Data sharing</td>
<td>73</td>
<td>5</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>• Up-to-date information</td>
<td>74</td>
<td>5</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>• Data validity</td>
<td>75</td>
<td>5</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>• On time treatment</td>
<td>76</td>
<td>5</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>• Correct treatment</td>
<td>77</td>
<td>5</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>• Reduction in data loss</td>
<td>78</td>
<td>5</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>• Data can be accessed at any time</td>
<td>79</td>
<td>5</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>• Data integrity</td>
<td>80</td>
<td>5</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>• Data availability in the clinical physiology module</td>
<td>81</td>
<td>5</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>• Data availability in lab medicine Clinical Module</td>
<td>82</td>
<td>5</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>• Reduction in response time of the system</td>
<td>83</td>
<td>5</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>Improvement in system responsiveness</td>
<td>• Data availability in the clinical physiology module</td>
<td>84</td>
<td>5</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>Improvement in resource usage</td>
<td>• Data availability in lab medicine Clinical Module</td>
<td>85</td>
<td>5</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>• Data sharing</td>
<td>86</td>
<td>5</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>• Data can be accessed at any time</td>
<td>87</td>
<td>5</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>• Data documenting</td>
<td>88</td>
<td>5</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>Compatibility of the entire IT infrastructure</td>
<td>• Multi-contexts support</td>
<td>89</td>
<td>5</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>• Scalability of applications</td>
<td>90</td>
<td>3</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>• Usability of applications</td>
<td>91</td>
<td>4</td>
<td>3</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>• Single Sign-On (SSO)</td>
<td>92</td>
<td>5</td>
<td>2</td>
<td>10</td>
</tr>
</tbody>
</table>
### Table 5-1 Continued

<table>
<thead>
<tr>
<th>Enterprise System effects</th>
<th>Performance indicator (PI)</th>
<th>PI affected</th>
<th>(i)</th>
<th>(a)</th>
<th>(b)</th>
<th>(a^*b)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improvement in data security</td>
<td>• Reduction in data loss</td>
<td>93</td>
<td>5</td>
<td>2</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Protection of patients’ privacy</td>
<td>94</td>
<td>5</td>
<td>2</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Reduction in human errors</td>
<td>95</td>
<td>5</td>
<td>2</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Single Sign-On (SSO)</td>
<td>96</td>
<td>5</td>
<td>2</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Reduction in system shut-down</td>
<td>97</td>
<td>5</td>
<td>3</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Data integrity</td>
<td>98</td>
<td>5</td>
<td>3</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Data sharing</td>
<td>99</td>
<td>5</td>
<td>2</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Up-to-date information</td>
<td>100</td>
<td>5</td>
<td>3</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Data validity</td>
<td>101</td>
<td>5</td>
<td>3</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• User authority and using range</td>
<td>102</td>
<td>5</td>
<td>3</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Transformational effects</td>
<td>Customer relationship</td>
<td>103</td>
<td>5</td>
<td>2</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Reduction in patient waiting time</td>
<td>104</td>
<td>5</td>
<td>2</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Increase patient satisfaction</td>
<td>105</td>
<td>5</td>
<td>1</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• On time treatment</td>
<td>106</td>
<td>5</td>
<td>1</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Correct treatment</td>
<td>107</td>
<td>5</td>
<td>2</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Protection of patients’ privacy</td>
<td>108</td>
<td>5</td>
<td>2</td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

**Sum of the \((a_i * b_i)\)**

\[1225\]

* \(i\) is the numerical order of the (ES effect–PI) couple.

* \(a\) is the importance of the PI: from unimportant (1) to very important (5).

* \(b\) is the degree of the PI’s variation induced by the ES effect: None (0), weak (1), medium (2), strong (3) (Uwizeyemungu, S., Raymond L., 2009)

This table 5-1 summarized all of the data from empirical data. The table below summarizes some important business processes according to the interview and these processes are categorized as automational effects, informational effects and transformational effects based on the theory, which are the effects brought by ERP system. For each business process, there are performance indicators (PIs) summarized from the organizational documents and interview, which is used to evaluate the effect from different aspects. The explanation and analysis is available in the following pages.
5.1 Automational effects perceived

1. Efficient work processes

From the interview, the implementation of ROS system is mainly to replace their traditional paper work in order to realize automatic work processes. The ROS system as an enterprise system is not only equipped with the major enterprise system characteristics such as data integration, SQL database management and real-time information, but also customized to provide more efficient work process with several functions. The mean value of the importance in this part is 4.86. Therefore, all the performance indicators correspond with this system effects are perceived as very important.

However, the mean value of the degree of system impacts is 2.13 which means that the degree of system effects is medium.

The quality of output information, multiple-functions support and number of “clicks” is weakly affected by the system. Therefore, such performance indicators are not good satisfied.

2. User friendly interface

The user friendly interface tends to be very important, because the mean value is 4.88. A good system interface can attract more users to use the system and improve the user satisfaction. In addition, the user friendly interface can directly influence the convenience of work process, in other words, efficient work processes.

Nevertheless, the mean value of the degree of system impacts is 1.81 that is less than medium degree.

The same problems as mentioned above: quality of output information, multiple-functions support and numbers of “clicks” are reducing the degree of system effects in this part as well.

3. Better management and monitoring tasks

The mean value of the importance of this system effects is 5 which means very important. The new business processes provide automatically way to manage and monitor order delivery and other tasks in order to support daily work efficiently and more security.

The mean value of the degree of system impacts is 2.2 that is near the medium impacts.

There the actual impact of management and monitoring should be improved. The most of the corresponding PIs are not affected fully. However, User Authority and Using Range and Errors Reduction is affected fully, which have strong impacts.

4. Stability
An Enterprise system is more stable than non-Enterprise system. The ROS system also has such characteristic. The mean value of the importance is 4.83. Therefore, this system effects is perceived as very important.

The mean value of degree of system impact is 2.60, which is more than medium. Therefore, the ROS system is building a stable work environment for the organization.

However, the human errors and data loss are still risky, because these PIs are not affected by ROS fully.

5. Elimination of redundancies

This system effect is very important to the business process with high score 5 equal to very important.

The mean value of impact degree is 2.40, which is more than medium. The PIs are satisfied well but the system response time is not affected enough.

6. Improvement in Order control

In the target business process, order control is the main activity. Thus, this effect should be very important. Comparing with the mean value, the result is same, which is 5 equal to very important.

But the degree of system impacts is 2.16, which just stay at medium state.

The multiple function support and number of “clicks” are the main problems influence the results. For better control of orders, multi-functions are needed to support daily work process, but the ROS system has did less contribution on it.

7. Integration of resources

Integration of resources is the main characteristics of the ES. ROS system should keep this effect as very important. The mean value is 5 which has already proved this point adequately.

The degree of system effects is 2.70 which are near to the strong effects. The integration of clinical physiology and lab Medicine database are efficient provide easier work process and improve the performance of the business processes.

5.2 Information effects perceived

1. Precision and accuracy of data

Because the ROS has data warehouse and network support, the real time information, data validity and data integrity is good. The accuracy of data is very important effects for organization, because these data directly influence decision making and other relative work processes. The mean value equal to 5 has already shown the truth.

The degree influenced by system is 2.6. It is between medium and strong. The human error is unavoidable and reduces performance.
2. Improvement In System Responsiveness

The mean value of system responsiveness is 5 which means very important, but the degree of this impacts is 2.33 which is medium impact.

A better system responsiveness can improve the system response time and indirect improve user satisfaction. Therefore, this impact should be improved.

3. Improvement In Resource Usage

The mean value of the importance of this effect is 5. So this effect should be very important.

As data warehouse and integration are the main characteristics of an enterprise system, the ROS system integrated several applications, system and database to support daily works, for example, the user can be able to get the information from Lab. Medicine and physiology. It is very important part to help users get information and improve their work process in order to build effective and efficient work process.

To compare with the mean value of the degree of this impact which is 2.8 and tends to be strong impact, it shows that this system effect fully impacts on the corresponding business process. Most of PIs have been affected fully.

Therefore, the results of this effect prove that the ROS system fulfill the motivation of ROS system adoption and implemented successfully. It will be the strength of ROS system.

4. Compatibility Of The Entire IT Infrastructure

The importance of compatibility of entire IT infrastructure is not kind of important, which is 4.25. The Scalability of applications and Usability of application is not concerned he as very important effects, because both of them are not determined as high important effects.

The mean value degree of the impact is 2.5 which can be analyzed as a good result. The value is between medium and strong. Comparing the importance of this effect, the system has made better performance.

5. Improvement In Decision Making

The decision making improvement should be a very important change for the business process, because the mean value of importance is 5.

The project leader tends to make the system more useful for helping doctors and nurse to make the right decisions for patients, because two of the PIs are on time treatment and correct treatment.

However, the mean value of the degree of system effect is 2 which equal to medium. Moreover, the on time treatment and correct treatment just make weak impacts. Therefore, the ROS system cannot be used for support the decision making effectively.
6. Data Security
The mean value of the importance of data security is 5. It means that the security is perceived as very important. The mean value of impacts degree is 2.6. It is still between medium and strong. The human error is still a risk.

5.3 Transformational effects perceived

1. Improvement in customer relationship
To improve the customer relationship is the common purpose for every organization in real world. Therefore, this effect is perceived as very important, it means the mean value is 5. However, the degree of system impacts is not as good as expected results. The mean value is just 1.60. It is less than medium. The main problems are some indirect effects from automational and informational dimensions.

5.4 ROS System Final Evaluation Results

According to the data from table 5-1 and the algorithm of ESEM below:

\[
\text{Sum1: } \sum_{i=1}^{n} = (a_i \times b_i) \\
\text{Sum2: } \sum_{i=1}^{n} = (a_i \times c)
\]

a stands for the importance of PIs (1-5), b stands for the degree of the PI’s variation affected by the ES effect (0-3) and c is the constant, (if \(b_i \geq 0, c = 3\)). Sum1 of \((a \times b)\) stands for the actual results of system effects. The Sum2 stands for the full score of system effects (perfect value). The sum of \((a \times b)\) has already gotten its results. It is 1225 that stands for the actual system performance. For comparing with the expected performance, it is needed to introduce the second formula. The sum of \((a \times c)\) stands for the maximal score of ROS system and the result is 1599.

Therefore, the ideal score of ROS system is 1599; the actual score is 1225.

For more meaningful and intuitive way to understand the results, the third formula is used for transpose the result:

\[
\text{Score} = 5 \times \left( \frac{\text{Sum1}}{\text{Sum2}} \right)
\]

It can be directly transpose to a more common score. The scale can be followed 5 points standard (very weak: 1, weak: 2, medium: 3, strong: 4, or very strong: 5) that stands for the contribution of the ROS system to corresponding organizational performance.

According to the formula, the final score of ROS system is 3.83. The score is close to the strong value, that is, a strong contribution of ROS system. Comparing with the mean value of user satisfaction survey, which is presented in the empirical data, 3.70, the results are very similar. Therefore, the final score of ROS evaluation is significant and trustworthy.
6 Conclusion

In this section the research questions are answered. Two contributions are presented. A proposal of future research is discussed based on the current contributions and new-found knowledge.

This thesis presents a practice for enterprise system evaluation issues by using existing evaluation model. This research focuses on health care area and chooses Jönköping County Council’s ROS system to be the target system. There are two contributions of this study.

The first contribution of this study is to answer the research questions by analyzing the target enterprise system – ROS system:

**What are the Enterprise Systems Effects which impact on business processes?**

<table>
<thead>
<tr>
<th>BP</th>
<th>SEs</th>
<th>Automational Effects</th>
<th>Transformational Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operation-</td>
<td>Stability</td>
<td>Precision and accuracy of data</td>
<td>Customer relationship</td>
</tr>
<tr>
<td>al process</td>
<td>Elimination of redundancies</td>
<td>Improvement in system responsiveness</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Efficient work process</td>
<td>Compatibility of the entire IT infrastructure</td>
<td></td>
</tr>
<tr>
<td></td>
<td>User-friendly interface</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Integrated resources</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Improvement in order control</td>
<td></td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>Better management and monitoring tasks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Management process</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- To what extend do the ES effects impact on the business processes?
  - By using the ESEM algorithm, the final score of the system is 3.83.
  - The degree of the ROS system effects impact on the business process tends to be strong. In other words, the ROS system strongly fulfills both managers’ and users’ demands on the whole.
  - The table 5-1 illustrates details of the degree of the all of the system effects.

The second contribution is that this study successfully brings the theory to the real world organization in order to evaluate their enterprise system. As many organizations ignore the linkage between system effects and PIs, some problem and unreasonable results cover the truth.
Managers can use the evaluation results to perceive the difference between the expected results and actual results in order to find out the existing problems.

However, the ROS system is not used for support the whole Jönköping County Council’s organizational processes. The evaluation result of ROS system only acts on the corresponding work processes such as clinic, lab medicine and pathology. Moreover, because it should consider about the delay of radiology module implementation, the evaluation result can only explain the clinic physiology module’ performance.

6.1 Further study

This paper provided a practice of using the evaluation model to assess the system during the post-implementation phase in the context of health care area. The research purpose of this paper is to identify the business processes affected by the ES effects and then evaluate them. However, as the resource limitation, there are still problems left.

As mentioned in the previous sections, because of the resource limitation, the Enterprise System Effects Evaluation model is adopted part of from the original one. The adopted part of the model is mainly focus on the local-level, which means to investigate the system effects and business processes in the particular area rather than study the organizational-level. Therefore, further study is to complete the study of the model and extend the research to the organizational processes and performance indicator in order to evaluate the system effects which impacts on the whole organization.

On the other hand, considering the context of the Jönköping County Council, it could be interesting to study the connection with the external partners (LIÖ) and the system provider (EDB). As the Jönköping County Council is known as managing the IT assets well, it is also interesting to study their management experiences, for instance, the experience of using BSC in the organization, the IT governance, etc. It is necessary to say that the Jönköping County Council is a successful case of improving their business with the use of IT, so it is worthy to explore the experiences of using IT in this organization.
List of references


L. McKee; E. Ferlie; P. Hyde, (2008), *Organizing and Reorganizing: Power and Change in Health Care Organizations*, Palgrave Macmillan


Appendix 1 Ros system testing Enviroment

ROS testmiljö
Appendix 2 Interview Questions

1. What is the enterprise systems implemented in your organization?

2. What is XROS project?

3. What is ROS system?

4. What is the motivation of implementing the system?

5. Can you describe the previews business process before ROS implemented?

6. What are the changes of business process after ROS implemented?

7. Which processes or sub-processes are affected by the system?

8. How do you determine these effects?

9. Which are the direct effects or indirect effects?

10. Do you have performance indicators?

11. How well does ROS system meet the stated needs of the business activities?

12. What were the most significant issues on this project?
Appendix 3 Performance Indicators (PIs)

1. Support for market standards
2. Reduction in number of work accidents
3. Reduction in number of system errors
4. Reduction in human errors
5. Reduction in data loss
6. Reduction in system shut-down
7. Reduction in data redundancies
8. Reduction in the operating costs
9. Data documenting
10. Data classification
11. Reduction in response time of the system
12. Ambiguity of responsibility
13. Reduction in number of “click”
14. Up-to-date information (real – time information)
15. Data sharing
16. Tacking information
17. Multiple-functions
18. Data validity
19. Data integrity
20. Reduction in labor costs
21. Usability of applications
22. Reduction in wastage
23. Quality of output information
24. Usability of current functions
25. Single Sign-On
26. User authority and using range
27. Access to data at any time
28. Multi-context support
29. Data availability in lab medicine Clinical Module
30. Protection of patients’ privacy
31. Increase patient satisfactions
Appendix 4 ROS System User Satisfaction Survey (english version)

Hello! Thank you for doing the survey. This survey is anonymous. The answer should be based on your actual experience with ROS system. The results of the survey will be used to evaluate the ROS system and improve the system. Thank you very much for your help!

* Required

What is your job title? *

Which department are you in? *

Your gender *

- Male
- Female

Your age *

Over 20 years

1st How long have you used the ROS system? *

2nd ROS system is easy to use. *

1 = strongly reject; 2 = disagree; 3 = Neutral; 4 = Agree; 5 = Agree strongly

3rd It is easy to remember how to use ROS system after I learned? *

1 = strongly reject; 2 = disagree; 3 = Neutral; 4 = Agree; 5 = Agree strongly

4th If the ROS system is not compulsory to use, I still want to use it. *

1 = strongly reject; 2 = disagree; 3 = Neutral; 4 = Agree; 5 = Agree strongly

5th The interface of the ROS system is user friendly. *

1 = strongly reject; 2 = disagree; 3 = Neutral; 4 = Agree; 5 = Agree strongly

6th The information from the ROS system is accurate *

1 = strongly reject; 2 = disagree; 3 = Neutral; 4 = Agree; 5 = Agree strongly
7th Information in the ROS system is sufficient. *
1 = strongly reject, 2 = disagree, 3 = Neutral, 4 = Agree, 5 = Agree strongly

Strongly reject 0 0 0 0 0 Agree strongly

8th ROS system displays current information. *
1 = strongly reject, 2 = disagree, 3 = Neutral, 4 = Agree, 5 = Agree strongly

Strongly reject 0 0 0 0 0 Agree strongly

9th When I use the ROS system, can I find information I need quickly. *
1 = strongly reject, 2 = disagree, 3 = Neutral, 4 = Agree, 5 = Agree strongly

Strongly reject 0 0 0 0 0 Agree strongly

10th Although I am not in my office, I have access to my patient information via the ROS.
1 = strongly reject, 2 = disagree, 3 = Neutral, 4 = Agree, 5 = Agree strongly

Strongly reject 0 0 0 0 0 Agree strongly

11th Med using the ROS system, I can diagnose my patients properly. *
1 = strongly reject, 2 = disagree, 3 = Neutral, 4 = Agree, 5 = Agree strongly

Strongly reject 0 0 0 0 0 Agree strongly

12th Med using the ROS system, I can diagnose my patients on time. *
1 = strongly reject, 2 = disagree, 3 = Neutral, 4 = Agree, 5 = Agree strongly

Strongly reject 0 0 0 0 0 Agree strongly

13th Using the ROS system, it is more convenient to communicate with patients. *
1 = strongly reject, 2 = disagree, 3 = Neutral, 4 = Agree, 5 = Agree strongly

Strongly reject 0 0 0 0 0 Agree strongly

14th ROS system to protect patient privacy. *
1 = strongly reject, 2 = disagree, 3 = Neutral, 4 = Agree, 5 = Agree strongly

Strongly reject 0 0 0 0 0 Agree strongly

15th ROS system ensures patient safety significantly. *
1 = strongly reject, 2 = disagree, 3 = Neutral, 4 = Agree, 5 = Agree strongly

Strongly reject 0 0 0 0 0 Agree strongly

16th ROS system significantly reduces patient waiting time for results. *
1 = strongly reject, 2 = disagree, 3 = Neutral, 4 = Agree, 5 = Agree strongly

Strongly reject 0 0 0 0 0 Agree strongly
| 17th ROS system makes it possible for me to get information from other systems. * |
|---|---|---|---|---|---|
| 1  | 2  | 3  | 4  | 5  |
| Strongly reject | | | | Agree strongly |

| 18th Until now, I never lose data by using the ROS system. * |
|---|---|---|---|---|---|
| 1  | 2  | 3  | 4  | 5  |
| Strongly reject | | | | Agree strongly |

| 19th ROS system helps me to categorize patients. * |
|---|---|---|---|---|---|
| 1  | 2  | 3  | 4  | 5  |
| Strongly reject | | | | Agree strongly |

| 20th ROS system helps me to track patient information. * |
|---|---|---|---|---|---|
| 1  | 2  | 3  | 4  | 5  |
| Strongly reject | | | | Agree strongly |

| 21st ROS systems help me to make decisions in time. * |
|---|---|---|---|---|---|
| 1  | 2  | 3  | 4  | 5  |
| Strongly reject | | | | Agree strongly |

| 22nd ROS systems help me to make the right decision. * |
|---|---|---|---|---|---|
| 1  | 2  | 3  | 4  | 5  |
| Strongly reject | | | | Agree strongly |

| 23rd ROS system makes my job easier than before. * |
|---|---|---|---|---|---|
| 1  | 2  | 3  | 4  | 5  |
| Strongly reject | | | | Agree strongly |

| 24th I think I need more training to learn how to use the ROS system. * |
|---|---|---|---|---|---|
| 1  | 2  | 3  | 4  | 5  |
| Strongly reject | | | | Agree strongly |

| 25th until now, I am satisfied with the system. * |
|---|---|---|---|---|---|
| 1  | 2  | 3  | 4  | 5  |
| Strongly reject | | | | Agree strongly |

| 26th Do you have any suggestions for the ROS system? * |
|---|---|---|---|---|---|
| Your suggestions can help us to improve the ROS system. |

Submit
### Appendix 5 Seven Steps of ES Evaluation Method

<table>
<thead>
<tr>
<th>Description</th>
<th>Illustration</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1)</strong> Repertory all operational and managerial processes and sub-processes, with the required level of detail. To do so, one may refer to the APQC’s (2006) process classification framework, and adapt it to the organization.</td>
<td><img src="image" alt="Organizational processes" /></td>
</tr>
<tr>
<td><strong>2)</strong> Identify all processes and sub-process affected one way or another by the ERP system.</td>
<td><img src="image" alt="ERP system" /></td>
</tr>
<tr>
<td><strong>3)</strong> Identify performance indicators applied to the affected processes and sub-processes (local level), as well as organizational performance indicators (global level); determine the degree of importance of each indicator (from [1]: unimportant to [5]: very important).</td>
<td><img src="image" alt="ERP system" /></td>
</tr>
<tr>
<td><strong>4)</strong> Determine the ERP effects on the various processes as perceived by members of the organization (managers and system users); account for direct effects versus indirect effects, expected effects (realized or not, or whose magnitude do not meet expectations) versus unexpected effects, and present effects versus potential effects.</td>
<td><img src="image" alt="ERP system" /></td>
</tr>
<tr>
<td><strong>5)</strong> Establish the correspondence between the ERP effects realized and the various performance indicators.</td>
<td><img src="image" alt="ERP system" /></td>
</tr>
<tr>
<td><strong>6)</strong> Determine to what extent the ERP effects realized impact the corresponding performance indicators (no impact [0], weak impact [1], medium impact [2], strong impact [3], with a minus sign if impact is negative).</td>
<td><img src="image" alt="ERP system" /></td>
</tr>
<tr>
<td><strong>7)</strong> Analyze the results obtained: compare these with expectations, question the reasons why expected effects were not realised, why they were over-evaluated (or under-evaluated); question the opportunity to extend the ERP system to unaffected processes, the potential effects of the system and the conditions required for their realization; determine the measures to be taken for a better exploitation of the system; and establish the objectives for the next evaluation.</td>
<td><img src="image" alt="ERP system" /></td>
</tr>
</tbody>
</table>