



**UHASSELT**

KNOWLEDGE IN ACTION

## Faculty of Business Economics

Master of Management

### **Master's thesis**

***Managing the implementation of a Hospital Information System: An implementation procedure***

#### **Arno Dops**

Thesis presented in fulfillment of the requirements for the degree of Master of Management, specialization Business Process Management

#### **SUPERVISOR :**

dr. Niels MARTIN



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## **Abstract**

A Hospital Information System (HIS) has been around for the last two decades known as an information system divided into several separate systems such as an accounting system, an administrative system, and an electronic patient record. A HIS is derived from an Enterprise Resource Planning (ERP) system, which are information systems used by companies to support their business processes. In 2010, a HIS became more unified by combining several systems, used in a hospital, into one system. A HIS can be defined as an information system which is designed to manage the administrative, clinical, and financial aspects that are part of the daily operations of a hospital. A HIS will not only decrease the potential errors, it will also help increase the efficiency, the quality of the healthcare services, the timely decision making, and the cost effectiveness. As this is one, unified system which is active in all departments of a hospital, the difficult part is implementing this system within a hospital. The aim of this research is to develop an implementation procedure which can support future HIS implementation for hospitals. In order to develop such a model, a thorough literature study was conducted in which three factors were found which affected the implementation of a HIS. The first one was concerning human factors. The second factor was concerning the managerial and organisational factors. The third factor regarded the technological factors. Once these factors were known, a second literature study was done in order to develop a literature-based implementation procedure. This literature study focused on implementation plans and procedures for an ERP system implementation project. With the three factors, which affect a HIS implementation, and with the ERP implementation procedures, the synthesised literature-based procedure for a HIS implementation was formed. In order to validate this synthesised procedure, three case studies in three hospitals were done in which in-depth interviews were conducted. Based on these results the procedure was validated and adjusted as the case studies implied that similar steps were being focused on during their HIS implementation project. The validated procedure consists out of three stages. The first stage is the Planning stage, which has five steps. The first step explains that a project management team should be composed. In the second step, this project team will need to establish the objectives which the HIS implementation should meet. Step three talks about a plan in order to reach the previously set objectives. In step four, the focus is on designing the system. The last step of this stage is concerning organizational learning, educating the employees. Stage two is the Implementation stage, which consists out of three steps. In the first step, the HIS needs to be adapted to the organizational structure. In step two, the system needs to be implemented in a test environment. If problems are found during these tests, it will go back to step one where these possible problems will be resolved and tested again. Once everything is thoroughly tested, step three will be the launch of the system. Stage three of the procedure explains the project evaluation and the aftermath of the launch. The project group needs to check if the objectives, which were set in the beginning of the project, were achieved. This stage will also evaluate if the system is still up-to-date within the fast-changing environment of today, meaning that it will be checked if system updates are needed. During these three stages, it is important to inform the employees about the project. When employees feel engaged in the project, they will have more trust in the project, which means less resistance and more participation. The use of this implementation procedure will help guide hospitals during their implementation of a HIS and will increase the likelihood of a successful implementation.



## **Acknowledgements**

This master's thesis serves as the final challenge in order to obtain the degree of Master of Management, Business Process Management. My interest in the possibilities of information systems, as well as my connection to the medical sector, thanks to my family, formed the basis of my choice for this topic. The journey of finishing this research was a very educational one, with experiences which I will carry throughout my professional career.

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# 1. Introduction

Throughout the end of the 20<sup>th</sup> century, hospitals realized the potential of using computers systems in order to facilitate their administrative, financial and clinical needs. This kind of system was quickly called an Hospital Information System (HIS). A HIS can be defined as an information system (IS) which is designed to help managing the administrative, clinical, and financial aspects that are part of the daily operations of a hospital. A HIS will not only decrease the potential errors, it will also help increase the efficiency, the quality of the healthcare services, the timely decision making, and the cost effectiveness (Sulaiman et al., 2014). A HIS is thus a system, which can exist out of multiple modules, which will help hospitals to support its operations such as management of financial, clinical and administrative data.

The problem with such a system is getting it up and running within a hospital. The implementation of a HIS is a very difficult task as these kind of projects needs to focus on several factors, such as human, technological and managerial and organizational, in order to successfully implement such a system. This paper will discuss these three categories of factors which influence the implementation (Ahmadian et al., 2014; Farzandipur et al., 2016). These factors and their problems can be very challenging obstacles for a successful implementation and can have a big financial and time increasing impact. However, most of these obstacles can be tackled by thorough planning. In order to plan such a project, a procedure should be used in order to prioritize on these categories and obstacles.

Therefore, this paper proposes a literature-based implementation procedure. This procedure contains several steps which hospitals need to focus on during the implementation of a HIS. These steps were based on existing implementation plans for Enterprise Resource Planning (ERP) system while considering the factors which influence a HIS implementation, as well as HIS planning procedure which solely focused on the planning stage of an implementation. Interviews were conducted with hospitals in order to validate this proposed literature-based implementation procedure. Based on these interviews, the different steps of the procedure were mostly validated, with the exception of some minor adjustments. With these results, the author extends the research of hospital information system implementation. The implementation plan conducted in this research can support future HIS implementations for hospitals.

The structure of the paper is as follows. Chapter 2 describes the methodology used during this research. Chapter 3 provides an overview of the literature which was used during this research. Chapter 4 defines the procedure on implementing a hospital information system. In chapter 5, the results of the case studies will be shown. Chapter 6 will cover the discussion of the procedure based on the case studies. Chapter 7 will define the conclusion, the study limitations, and any possible recommendations for future research.



## **2. Research questions & Methodology**

### **2.1. Research questions**

The main research question used for this study reads *"Which procedure should be followed during the implementation of a Hospital Information System?"*. In other words which key steps are necessary to focus on when implementing a Hospital Information System.

After a preliminary study, it was clear that literature did not provide an implementation procedure for a Hospital Information System. Therefore, the following sub-questions were formed. First, this study looked at *"Which factors can influence the success or failure of a Hospital Information System?"*, and *"Which procedures are defined in the literature regarding the implementation of a Hospital Information System or closely related type of information systems?"*. The synthesised procedure section was based on the following question *"Which procedures needs to be followed during a Hospital Information System implementation, based on insights from literature?"*. The last sub-question reads *"Is the literature-based procedure endorsed by domain experts in hospitals?"*, in order to validate the synthesised procedure.

### **2.2. Literature review methodology**

In order to ensure a thorough review of the literature with a high quality, multiple procedures were used. First a thorough examination of peer-reviewed and scholarly journals, books, dissertations, ... was done based on keywords such as "Hospital Information System", "Hospital Information System & implementation", "Hospital Information System & implementation & factors", "Hospital Information System & modules", "Hospital Information System & implementation & procedure", "Information system", "Information system & implementation", "Information system & implementation & procedure", "Information system & implementation & factors", "Information system & hospital", "ERP & implementation", "ERP & implementation", "ERP & implementation & factors", "ERP & implementation & procedure", etc. These keywords were used in databases such as Google search engine, Google Scholar and UHasselt Discovery Service. Secondly, forward and backward citation chaining was used on the literature that were found in order to get a more detailed view and any additional literature. Forward citation chaining is looking whether a study has been cited by other studies after its publication. Backward citation chaining is the opposite were the researcher looks at the reference list of a specific work (Hinde et al., 2015). Using this kind of search process, 44 pieces of literature were found that were published between 1997 and 2019. The relevant papers were then analysed in order to find the factors which affected an implementation as well as Enterprise Resource Planning system implementation procedures. This information was then used to adapt an information system implementation procedure into a Hospital Information System implementation procedure.

## **2.3. Case study methodology**

In order to collect the data which is necessary, this research will adopt a case study method. Yin (2014) explains that a case study can recognize certain patterns of relationships across constructs. This study aims to develop a procedure concerning the implementation of an hospital information system, therefore a qualitative analysis is preferred over a quantitative one.

### **2.3.1. Data collection and analysis**

In order to find the required data, this study adopted case studies with in-depth interviews as the data collection method. The interviews will follow the semi-structured format which means that the interviewer prepared some 'key' questions which need to be covered during the interview. However, additional questions may arise based on the flow of the interview. Saunders et al. (2016) explain that "... *semi-structured interviews provide the researchers with the opportunity to 'probe' answers, where you want the interviewees to explain their responses*". Therefore, this method was chosen as semi-structured interviews covers both the main topics which needed to be covered, and it can also clarify and further expand the view of the participant (Yin, 2014). In total three different case studies happened, during the 2-month period between October 2019 and November 2019. During these case studies three face-to-face interviews were conducted with a length of approximately 60 minutes. Before the interview, the participants signed a confidentiality agreement in which was explained that the interview was being recorded, that the use of the hospital's name was confidential and only the people who were working on the research would get insight, and that the participation of the interview was completely voluntary, and that the participant could stop at any time.

In order to analyse the interviews, they were transcribed in order to formulate a conclusion. The analysis happened by following the different steps of the procedure, analysing the three transcribes thoroughly for several times in order to make sure all the important data is used. Cresswell (2009) explains that the analysis of data involves recurrent reflection of the data. That is why the interview transcripts were analysed several times, in order for the researcher to become familiar with them and to conclude a proper conclusion.

### **2.3.2. Sample**

In order to gather the required data, it is important that the right cases, with 'key persons' for the research, are selected. In a case study, the most commonly used approach to get the right cases is the theoretical sampling approach. This means that the cases are not chosen for statistical reasons, but for theoretical reasons (Gibbert et al., 2010). In order to find these 'key persons', seven Belgian hospitals were contacted in order to get into contact with their IT director or the IT project manager. Out of these seven hospitals, three respondents agreed to participate in an interview. All the respondents were approached via email or by telephone and agreed to participate in the study.

### **2.3.3. Interview protocol**

To provide methodological underpinning for the interviews, an interview protocol is used. Yin (2014) describes this kind of protocol as a guide in order to find and contact respondents, conducting the interviews, analysing these interviews, and reporting the attained results. This protocol (Appendix

A) was developed by using interview themes, on which the questions are based. These themes are derived from the literature review and theories that are considered (Saunders et al., 2016).

The interview protocol starts by explaining the purpose of the interview, explaining what will happen with the gathered data. In the interview protocol, a contract between the interviewer and interviewee is constructed. It also incorporates the questions surrounding the planning stage, the implementation stage, the evaluation stage of an HIS implementation. As well as question about employee engagement during such a project and questions about the interviewee's background.



## 3. Literature review

### 3.1. Hospital Information System

In the early 1960s, larger hospitals began to install mainframes in order to make administrative and business functions more efficient. Ten years later, these mainframes were replaced by smaller, less costly computers which enabled hospitals to use special applications systems throughout different departments. This led to the development of a system currently known as a Hospital Information system (HIS). In the mid-1980s, the HIS was improved in order to enable a widespread availability of the local networks which enabled advanced database management capabilities. Over the next decade the HIS kept improving, for example by adding several other systems, such as the Electronic Patient Record (EPR) system/Electronic Medical Record (EMR) system and Electronic Health Record (EHR) system (Collen & Ball, 2015). An EHR is a collection of the complete electronic health record of a patient at a more longitudinal level (Kierkegaard, 2011). An EPR and EMR system are essentially synonyms, the terminology EPR is mostly used in European countries and the terminology EMR is mostly used in North American and Asian countries. An EPR/EMR system is also part of a HIS and focusses on the treatment and medical history of a patient in a particular medical department such as cardiology, neurology, ... These records usually stay within these departments (Habib, 2010). HER does all that and more, meaning this system focuses on the total health record of a patient. The system is designed to share its information beyond the health organization where the data was collected (Menachemi & Collum, 2011).

When looking at literature surrounding HIS, several definitions can be found. According to Haux et al. (2003) *"a Hospital Information System (HIS) is defined as the socio-technical subsystem of a hospital comprising all information processing systems as well as the associated human or technical actors in their respective information-processing roles"*. The definition Sulaiman & Wickramasinghe (2014) gave to a Hospital Information System (HIS) is *"a comprehensive, integrated Information System (IS) designed to manage the administrative, financial, and clinical aspects of a hospital. It influences the decrease in medical errors, growing the efficiency, cost effectiveness, timely decision making, and improving the quality of healthcare services."* The Medical Dictionary from Farlex (2009) defines HIS as *"a large computerized database management system that processes patient data in order to support patient care. The system is used by health care clinicians to access patient data and to plan, implement, and evaluate care."* When looking at the similarities of the different definitions, it can be concluded that a HIS is an important element for hospitals to support its operations such as management of financial, clinical and administrative data. This paper however will adopt the definition from Sulaiman & Wickramasinghe (2014) as the reference definition because it focuses more explicit on other aspects, such as administrative and financial, besides the clinical aspect. Compared to the other definitions which mainly focus solely on the clinical aspect. Implementing such a system can increase the efficiency and the safety of the current practices of a hospital, e.g. safety concerning patient data. HIS collects, extracts, stores, processes and links information that is necessary for a hospital to manage activities such as planning, coordination, decision making and monitoring in a hospital (Ahmadian et al., 2014).



A HIS can exist out of multiple modules covering the elements which were mentioned before. The most common modules are (Handayani et al., 2016; Reichertz, 2006):

- **Patient Management module:** which contains the following systems:
  - Medical records system: medical records of patients such as patient identification, diagnosis, ... are managed here;
  - Registration system: helps with covering all necessary information of a patient who needs to be registered;
- **Bed Management module:** system that helps with the bed allocation within the different wards;
- **Consulting Management module:** helps physicians to improve their appointment management;
- **Nursing Management module:** system that allocates nurses to specific patients or wards in order to provide the best patient care;
- **Medical Services Management module:** system that manages the different services that the hospital provides such as pharmacy, radiology, laboratory, cardiology and occupational therapy;
- **Order Communication System module:** helps the medical staff with the requests to carry out certain procedures that are needed on certain patients after a diagnosis;
- **Billing Management module:** prepares and calculates the billing and payment processes;
- **Material Management module:** supports with the purchase and supply of hospital equipment, inventory (drugs, surgical items, ...), non-medical materials.

As a HIS has such a large impact on the operations of a hospital, the correct implementation of such a system is of great importance. When researching how to implement an information system, three major approaches can be found. There is the direct conversion approach, the parallel approach and the hybrid approach. When choosing the path of the "direct conversion approach", the new information system will be implemented and go live on a single date. When the changeover of the system is done, the employees will immediately use the new system. As this change happens so abruptly, this method is also called the "big bang implementation method". The second method called "parallel implementation approach" is considered to be less risky compared to the direct conversion approach. This means that, for a period of time, both new and old information systems run in parallel. When a problem occurs, the old system will act as a back-up until the problem is resolved. Once the new system is considered to meet the requirements, the old system will be disabled. The third method is called the "hybrid implementation approach" which is a hybrid between a big bang approach and a parallel approach. This method implements the information system in several phases, several smaller big bangs. As the implementation happens over a certain amount of time, this method is often called an evolutionary approach or a phased approach (Zia & Bukhari, 2011). As all three of these implementation approaches have their pros and cons, there are some factors, independently from the implementation approaches, which affect the implementation of a HIS.

## **3.2. Factors affecting HIS implementation**

According to Farzandipur et al. (2016) a failed implementation of an information system project is difficult to define as the factors for a successful or failed project is diverse. But from an overall view, an implementation project is considered a failure when it does not meet the predefined goals and expectations. As stated before, various studies found that a lot of these HIS projects are faced with failure because of several factors which will be described in the next paragraph.

Before focusing on the factors affecting the implementation of a HIS, it can be helpful to look at factors affecting the implementation of information systems in general. Barker & Frolick (2003) did research concerning the factors influencing the implementation of an Enterprise Resource Planning (ERP) system. They concluded that in order for a successful implementation thorough planning, communication and employee involvement needs to get extra attention. Corkindale et al. (2013) agree by stating that training and project management are a core success factors for a successful implementation. Rajan & Baral (2015) mention both organizational and technical factors which an organization should understand in order to have a successful implementation. The organizational factors they refer to are the ease of use of a system as well as training in using the system. The technological factors concern more about the complexity and the flexibility of such a system.

Based on several case studies concerning the implementation specifically of a HIS, three main categories of factors can be found which affect the implementation. Firstly, there are the human factors which relate to either individual users of the system or to a group of users. Secondly, managerial and organizational factors cover the 'planning' of the HIS implementation. Finally, technological factors relate to technical limitations such as hardware or software challenges or to the HIS itself (Ahmadian et al., 2014; Farzandipur et al., 2016). Each of these factors have their own challenges which can potentially affect the implementation of a hospital information system. When comparing these categories with the factors of an ERP system mentioned above, a lot of similarities can be found.

### **3.2.1. Human factors**

Human factors are the physical and psychological behaviour of 'users/humans' in relation to certain events or environments, e.g. when changes happen (Farzandipur et al., 2016). These factors can influence the implementation of a HIS in either a positive or a negative way. The first challenge is the ability of users to use a computer and more specific a HIS (Farzandipur et al., 2016). A second challenge is the ease of using the HIS, but also learning how to use the specific system (e.g. is there a steep learning curve) (Langberg, 2003). When users have learned how to use the HIS in a proper way, they will feel more motivated to use the system and therefore experience more trust in the implementation of the system in general. The trust of the users in the implementation of a HIS and the system itself starts with their attitudes. According to Jeppesen et al. (2018) there are three types of attitudes towards a new system. The first type is the 'dedication of making the implementation work' (Emotional apathy). The second type implies that the user is 'frustrated but still trying to stay optimistic' (Incomplete training, unclear system use, ...). The third type talks about the users feeling 'despondent' (Insufficient coordination, us vs them mentality, ...). They do not only feel let down, but they also feel frustrated and hopeless. They lost the trust that the implementation will ever be

successful. Jeppesen et al. (2018) describes these previously mentioned attitudes as a lack of user support during the implementation of the HIS. That is why patience towards the system is considered an important factor in order to prevent negative attitude from colleagues (Ahmadian et al., 2014). Farzandipur et al. (2016) state that human factors are the most decisive for the success or failure of an implementation of a HIS. Ahmadian et al. (2014) states the opposite, based on their case study. They claim that the human factors are the least decisive for a successful or failed implementation of a HIS. However, both authors write about the 'same' problems that occur during an implementation.

### **3.2.2. Managerial and Organizational factors**

Literature outlines several potential problems which occur during the implementation of a HIS due to the managerial and organization factors. Farzandipur et al. (2016) highlight a problem that occurs, which relates to the human factor problem, of 'training the use of the system'. The initial required training, in order to use a new system, and a possible adaptation of the training campaigns should be considered at an organizational level. Farzandipur et al. (2016) refer to a case study by Kimiafar et al. (2007) which states that most users attribute the low quality of HIS to a lack of sufficient and relevant training. Gagnon et al. (2012) added that the participation in the implementation strategy by the end-user was one of the factors which influence a successful or failed implementation of a HIS. The participation can be compromised by the fear of users to lose their jobs because of the HIS, the fear of not knowing the new technology, and last the unwillingness to change (Farzandipur et al., 2016). The managerial and organizational factors have, according to Farzandipur et al. (2016), less influence on the implementation of a HIS compared to the human and technological factors. However, Ahmadian et al. (2014) stated that the managerial and organizational factors were considered to be a more decisive influence compared to the human factors but less decisive compared to the technological factors.

### **3.2.3. Technological factors**

According to Farzandipur et al. (2016) technological factors are the second most important, in between the human factors and the managerial and organizational factors, when it comes to affecting the implementation of a HIS in a positive or negative way. Ahmadian et al. (2014) state in their paper that the technological factors are the most decisive factor on the implementation compared to the other factors. Both authors agree that the main reason why technological factors have that kind of influence is because the HIS is responsible for the security of the patient's information and, therefore, has a bigger impact on the system development. When looking at the literature, three main problems can be found. The first problem within this factor is the 'inability of the supplier to deliver an acceptable product', which is a big obstacle when it comes to the implementation of an information system. The second problem of this factor is the 'concerns surrounding the ability that systems can communicate with each other'. This refers to the ability to exchange data between different departments or even between different organizations without compromising the security of the data (Gagnon et al., 2012). The third problem is 'the ability of the HIS to be flexible', allowing the system to respond to changes or modifications in a fast manner (Langberg, 2003). When such a system is flexible enough, it is easier to ensure its future development.

### **3.3. Information system implementation procedures**

Considering the challenges outlined in section 3.2, through planning and critically evaluating the progress of the implementation, the likelihood of a successful implementation will increase as commonly encountered pitfalls will be avoided or countered. In order to make sure such an implementation is successful, an implementation procedure should be used.

Literature does not specify such an implementation procedure for the implementation of a Hospital Information System (HIS). Literature does provide us a maturity model for a HIS, which describes different development stages which can be used by an organization to further develop and improve the HIS and the use of it (Carvalho et al., 2019).

As stated before, a HIS and ERP system are both considered Information Systems, e.g. both provide organization-wide support. This can be confirmed when comparing the factors affecting an ERP implementation, which show significant resemblance with the factors affecting a HIS implementation that were mentioned in section 3.2. Umble et al. (2003) listed common pitfalls of an ERP implementation. They examined the effects of human resources and operational factors on an ERP implementation. But they also mentioned the importance of the technological factors in such an implementation.

#### **3.3.1. Umble et al.'s critical factors**

Umble et al. (2003) did not develop a process plan in their research, but they did list common pitfalls of an ERP implementation and derived several critical factors which need to be focused on during an ERP implementation. After a case study of an ERP implementation at an international organisation, several critical factors were found.

The researchers expressed the importance of a clear understanding of the strategic goals. Meaning that there needs to be a vision of how the system should look like and how the organisation will operate using this system. It needs to be clear to the stakeholders why the new ERP system will be implemented. In order for an ERP implementation to be successful, the project will require extensive project management. This will include a team to define a detailed plan which include the project scope. This team should consist out of people based on their knowledge, experience, reputation and should possess decision authority. Once the team is settled, a study of the organizational structure needs to be done in order to check if the current structure and processes are compatible with the new ERP system. This can lead to an enforced reengineering of certain business processes in order to make it compatible with the new system.

Umble et al. (2003) recognize that employee training is the most important critical success factor for an ERP implementation. They state that user understanding, and trust are essential for a successful implementation. If users of the new system do not understand how it works, they are likely to adapt the processes to their liking and, therefore, the full potential of the ERP system will not be reached. That is why end user training should be extensive and started early in the implementation trajectory. Hence it is important that management allocates enough resources to this step. However, these training moments are just the start of the end users learning curve as most of the learning process happens from using the system when it is operational.

During the implementation, project evaluation measures should already be included. E.g. process measures such as number of trained users, number of training sessions held, ... This way the objectives, which were set in the beginning of the project, can be tracked and evaluated. With this information it will also be easier to identify errors, which require to be tackled (Umble et al., 2003).

### 3.3.2. Chang's five stage model

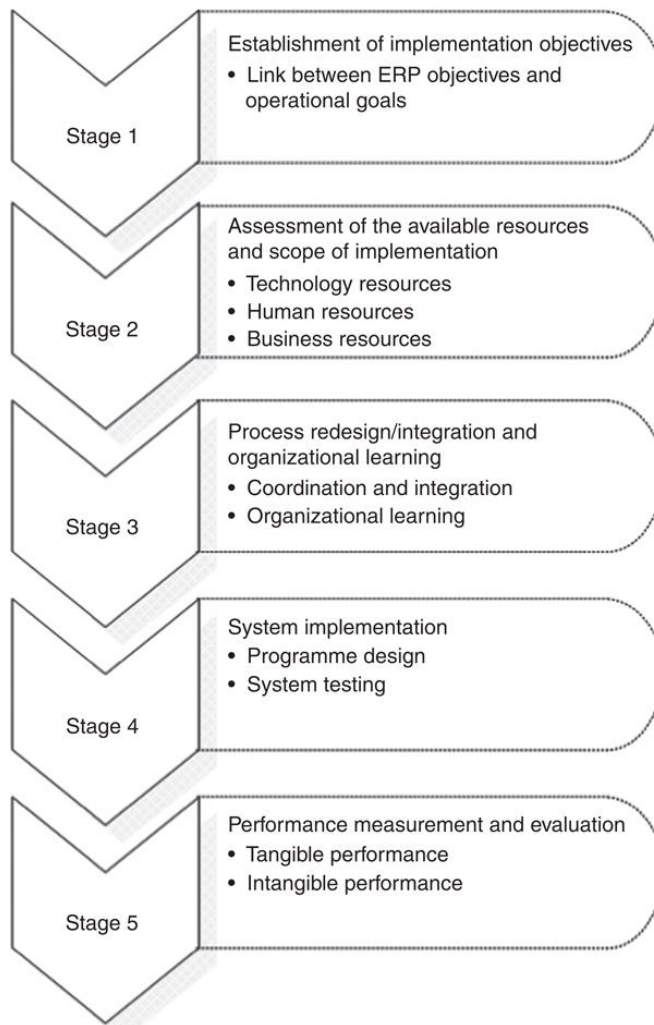


Figure 1: ERP implementation model (Chang et al., 2015)

Chang et al. (2015) developed a model for the implementation of an ERP system by combining previously developed implementation models. Based on Rajagopal's (2002) six-phase model, the five-stage accelerated SAP implementation method (Fleisch et al., 2004; Portugal & Sundaram, 2006), and the more recent 'Motivation-Emotion-Support-Strategy' approach (Von der Weth & Starker, 2010), Chang et al. (2015) proposed a five-stage model based on the previous models and a case study.

In the first stage it is important that the objectives of the implementation are set. The organisation will need to examine their operational goals and the goals which need to be met by the new information system in order to select the required modules (Chang et al., 2015).

The second stage will require an assessment of the available resources and the scope of the implementation. Knowing which resources are available will enable the allocation of the various resources to be more effective, e.g. appointing the right people to the right job. There are three resource categories based on study of Powell & Dent-Micallef (1997), firstly the technological resources which includes the information system's architecture and the technology which is used, for example the flexible integration of modules within the system. Secondly the human resources include the manpower which is available during the project. The final category is the business resource which is more focused on financial, physical and knowledge factors in order for a firm to perform their business processes, e.g. their production process (Chang et al., 2015).

The third stage requires the designing/integrating process of the ERP system, and organizational learning. This stage can be divided into two concepts: 'Coordination and integration' and 'Organizational learning'. The coordination and integration concept mainly deals with communication between management and the different departments. If this communication does not happen, this could result in major resistance from the users of the system. The second concept, organizational learning, refers to the importance of employee training and education which helps avoiding resistance from the system users. Therefore, organizational learning should start early, i.e. during the implementation of the system, and not wait until the system is online (Chang et al., 2015).

Stage four of the model is the development and the actual implementation of the information system. Developers examine the views of the users, ensuring that the system meets the goals which were set in the beginning of the project. Before the actual implementation, the information system should be tested thoroughly in order to deal with preventable issues (Chang et al., 2015). Shaul & Tauber (2012) emphasizes the importance of the testing stage, as neglecting it could lead to a delay in the implementation of the system.

The fifth and last stage takes place once the system is up and running, by measuring and evaluating the system performance. Within a running system tangible and intangible performance elements can be found, which needs to be monitored. The tangible elements concern about costs, benefits and operational time. The intangible ones include the integration of the system and the user satisfaction (Hwang & Grant, 2011; Chang et al., 2015).

Of the five given stages, Chang et al. (2015) concluded that stage three of the model is considered as the most critical stage during an implementation of an ERP system. They substantiate this by stating that, based on their case studies, the coordination, integration, and organizational learning are the key factors in getting the support of the employees. Which can determine the outcome of such an implementation project.

### **3.3.3. Gärtner & Kuttner implementation process**

Gärtner & Kuttner (2016) designed an implementation process model of an ERP system together with several propositions which are based on twenty case studies of Austrian enterprises.

#### ***Implementation propositions***

After deducting propositions which focused on the Austrian environment, the following propositions stood out:

- *"The provision of early initial information and continuous information on the ERP system implementation thereafter supports employee acceptance and enables timely adaption to the changes (e.g. organizational structure) in the company." (Gärtner & Kuttner, 2016, p. 83)*

Based on the interviews with the different companies, the importance of the point in time when employees are initially informed about the upcoming implementation of a new ERP system was often overlooked. Providing information about the project at an early stage helps the employees to adapt easier to the associated changes, concerning their specific activity. This will help them to better accept to project as a whole. After this initial contact, it is important that the employees feel that they are engaged with the implementation and its progress. This is done by regular updates, such as information about the training concept, which will help them to further learn about the ERP implementation progress and this will lead to a higher acceptance (Gärtner & Kuttner, 2016).

- *"The integration of key users ... in the ERP system project team supports a successful ERP system implementation. In particular, the members of an ERP system project team should have work experience, professional qualifications and know-how on process models." (Gärtner & Kuttner, 2016, p. 86)*

In order for an ERP implementation to be well organized, it is important to compose a project team which will lead the implementation. The formation of this team should be based on certain selection criteria such as process knowledge, IT affinity and team spirit.

- *"Besides the actual ERP system implementation, test runs, or test stages are considered to be important in the implementation stage, to identify and resolve weaknesses before the go-live of the ERP system." (Gärtner & Kuttner, 2016, p. 91)*

Once the system is developed and ready to be launched, it should first go through an extensive testing phase. The project team should conduct these tests in order to check for possible weaknesses and problems of the system and resolve them before the actual launch. Once this testing phase is done, the system can be launched, and the implementation is considered to be finished (Gärtner & Kuttner, 2016).

#### ***Implementation process model***

Based on the case studies, Gärtner & Kuttner (2016) developed a process model for the implementation of an ERP system. The first step is the planning stage where the project team is composed by integrating key users of all departments. Once the project team is set, a project plan needs to be developed in which the objectives of the implementation are set.

During the implementation phase, the organization should also determine the implementation strategy. Gärtner & Kuttner (2016) focus on two strategies, the 'Big Bang' strategy which means that the implementation has one milestone where all of the modules are implemented in one go. The second strategy is the gradual or phased implementation, which has several milestones, where the modules are implemented in different blocks of time. Once the strategy is chosen, the next step is the adaptation of the new ERP system to the organizational structure and in some rare cases vice versa (e.g. modifications for specific departments, the programming of the system interface). Afterwards, the first test implementation needs to happen where weaknesses and problems are filtered out. Once testing is finished, further adjustments of the organizational structure and ERP system happen. The last step in the implementation phase is going live with the ERP system and ideally follow it with an evaluation of the project (Gärtner & Kuttner, 2016).





## 4. Synthesised HIS implementation procedure

As the literature has a gap concerning an implementation procedure for Hospital Information Systems (HIS), a synthesised procedure consisting of 3 stages was developed each with their own steps (Figure 2). The procedure was based on the factors affecting the implementation of a HIS, Umble et al. (2003) their critical factors, the five-stage model for ERP implementation by Chang et al. (2015) and the implementation propositions and process model from Gärtner & Kuttner (2016).

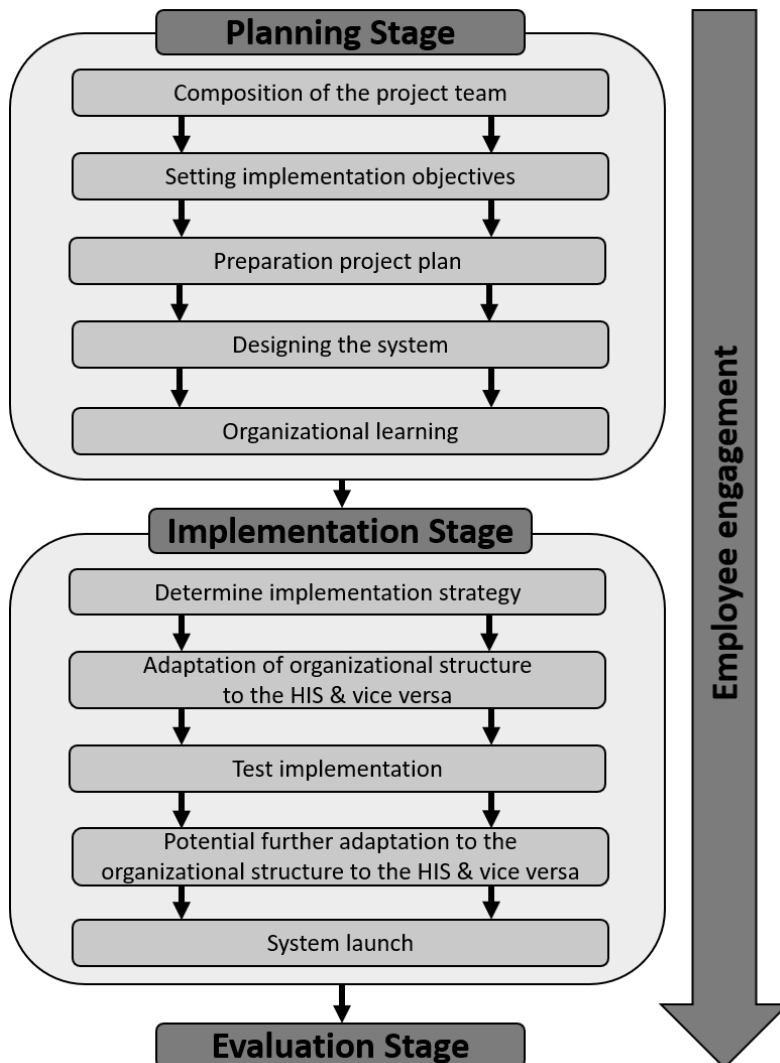


Figure 2: Synthesised HIS implementation procedure model

### 4.1. Stage one: Planning stage

The planning stage focusses on the initiation of the project. Who will lead the project? What is the target of the project? This stage consists four steps:

#### Step 1: Composing project management team

Once the strategic decision is made to implement a HIS, it is important that a project management team is composed which will guide the organization through every phase of the implementation. The project team should consist of a project manager, who is authorized to make decisions, and several key users of all the involved departments. The key users are chosen based on several criteria. The

first criterion is the professional qualifications and work experience of the candidate (Umble et al., 2003). The second criterion is the process knowledge of the candidate, which is *the* knowledge someone has about a certain process (Boreham et al., 2003). For example, the knowledge the head nurse has about the processes concerning washing patients. The third criterion is regarding that the candidate should have a certain IT affinity, in other words how comfortable the candidate is with IT and information systems. The fourth and last criterion is concerning the candidate's ability to work in a group environment, which Gärtner & Kuttner (2016) refer to as team spirit. When to project team is formed, it is important that the necessary knowledge of all the processes of each department is incorporated. External consultants may be added to the project team by the software company of the HIS or a consulting company.

## **Step 2: Establishing implementation objectives**

Once the project management team is composed, they will need to set the objectives of the HIS implementation. The project team should first examine the hospital's operational goals and the objectives the HIS should meet and link them together. The project team needs to define why the system is implemented and which modules are needed to be implemented (Chang et al., 2015). The vision that the project team has devised should be clear and compelling in order to empower all the stakeholders (Umble et al., 2003). Given the objectives, it is important that some general deadlines are added, for example when the project should start, when the project should be finished. More detailed deadlines, such as the time span of when certain components will be implemented or when the employee training should start, will be planned in the next step concerning the project plan (Gärtner & Kuttner, 2016).

## **Step 3: Preparing project plan**

After the objectives are set, the project management team needs to make a plan in order to reach these objectives (Umble et al., 2003). The first thing that needs to happen in the project plan is a thorough analysis of the present state of the current structure and operations, and the idea of the target state of how the new system should look like. In order to get the idea of the target state, external consultants can act as facilitators by giving their expertise in order to ensure that all required modules of the new HIS are contemplated and potential organizational blindness by the project team is countered (Gärtner & Kuttner, 2016).

After the analysis concerning the present and target state, a feasibility study should be done in which all resources are checked to determine the likelihood of successfully completing the project (Feasibility study, 2019). The first resources that need to be checked are the human resources, which are for example the time capacity of key users and the overall manpower that is available during the project (Chang et al., 2015). The second resources are the technological resources which concerns the available technology of the hospital, such as the availability of competent hardware. For example, if the hardware can manage the integration and communication of the different modules. The third resources are the business resources which concerns about the financial, physical and knowledge factors (I.e. licensing costs, business procedures) (Gärtner & Kuttner, 2016).

## **Step 4: Designing the system and organizational learning**

The fourth step will focus on designing the Hospital Information System and setting up the organizational learning plan. As the implementation of the HIS is done in several departments, it is important that there is a good communication between the departments and the project team. Communication is needed in order to define the demands and needs of the users which need to be incorporated in the design of the HIS. The software company can then design and adjust the system in order to meet the needs and demands of the users. Neglecting communication with the employees could harm their trust in the project and could result in resistance from them towards the system (Chang et al., 2015).

During the design stage, it is also important to start employee training and not wait until the system is live. During this training, the users can provide additional suggestions for the design of the system (Gärtner & Kuttner, 2016). Organizational learning is a critical factor throughout the whole project as it improves the employees' trust in the project and can, therefore, avoid possible resistance from them (Chang et al., 2015). During this training, employees will learn how to use the system, which will also help in them recognizing their 'critical tasks' (Chang et al., 2015). It is important that the users really get to know the new system. Because if the users do not understand the new system, they will adapt the newly introduced processes and invent a more, for them, convenient but less effective way. However, this is only a small part of the learning curve of the users as the most effective education is by experience (Umble et al., 2003). Early and thorough education will help tackle the challenges of the human factors, which were mentioned in 3.2.1, as the knowledge and skills of the user in using the new HIS will increase. Starting early with training will also make it easier to develop and plan the training campaign.

### **4.2. Stage two: Implementation stage**

During the implementation stage, the project team decides how to implement the newly designed system, the system will need to be adapted to the organization and it needs to be tested before it is launched. This stage consists of five steps:

#### **Step 1: Determining implementation strategy**

In the first step of the implementation stage, the project team determines the implementation strategy. The two most common strategies are the 'big bang' implementation strategy and the phased/gradual implementation strategy. With a 'big bang' implementation, the project team sets one milestone where all the different modules are launched at the same time. With a phased/gradual implementation, the project team sets several milestones in order to gradually implement each module, or a bundle of a few modules, in several blocks of time. This also means that the following steps need to be repeated in each implementation cycle (Gärtner & Kuttner, 2016).

Both implementation strategies have their advantages and disadvantages. A big bang strategy has fewer operating costs, the return on investment (ROI) will be faster as all changes happen for all the users at a certain date. A big bang strategy has a higher risk of the system not being ready at the given date. The organization may feel a disruption in their operations which could hinder their productivity. A phased strategy has a higher cost, as during the implementation both the old and

new system needs to be maintained and linked. There will be less of a risk as there are no hard deadlines, there will be a steadier performance as user can be educated more thoroughly. To determine the best strategy, factors such as operational expenses, productivity, initial costs and return on investment should be assessed (Kautz et al., 2009).

## **Step 2: Adapting the HIS to the organizational structure & vice versa**

In the second step, the new HIS needs to be adjusted to the organizational structure of the hospital, i.e. the interface needs to be programmed that it would work with the hospital's operating systems. Gärtner & Kuttner (2016) also mentioned that it could be done the other way around. So that the organizational structure will be adapted to the new HIS, which could mean modifying certain procedures, changing a way of working within a department in order for the HIS to be able to be operational. If the hospital already had certain systems in place before the new one, less adjustments will be needed. The adaptation of the HIS to the organizational structure and the organizational structure to the HIS are both interdependent. Meaning that the more the organizational structure is adapted to the system, the less adjustments are needed to be done of the system to the organizational structure and the other way around (Gärtner & Kuttner, 2016).

## **Step 3: Test implementation**

The third step is to implement the HIS into a testing environment. These tests should be conducted by the project team, the software supplier, and key users. It will look for weaknesses and problems of the system (I.e. data breaches, bugs, program crashes, ...), but it will also look for potential adjustments or adaptations. Neglecting the testing of the HIS could result in a delay of the whole project, as this could lead to endangering future deadlines due to possible setbacks which could have been avoided by proper testing. These kinds of setbacks could affect the employees' trust in the project or could even fail the entire implementation (Chang et al., 2015; Gärtner & Kuttner, 2016).

Several forms of testing can be done, a 'functional system testing' checks if all of the added features work and if they comply with the needs and objectives which were set in the beginning of the project. A second testing technique is the 'performance system test' which checks the performance of the HIS, if the system runs well. The 'integration system test' will test if the new system is integrated and if it is able to run together with other systems. An 'automated system testing' is done by letting a computer performs several tests which are done faster than testing them manually (Yusuf et al., 2004).

## **Step 4: Potential further adaptation of the HIS to the organizational structure and vice versa**

The fourth step will tackle issues which were encountered during the testing in the previous step. With the potentially new collected information, the system could be further adjusted to the organizational structure or the organizational structure could be adapted to the HIS. This step should only be done if necessary, i.e. if the results from the tests implied to do so (Gärtner & Kuttner, 2016).

## **Step 5: System launch**

The fifth and final step is the system launch, this is done by using the strategy that was chosen step 1 of this stage. In a big bang approach this means that the whole system is launched at one point in time. In a phased/gradual approach, every package/phase should start from step 2 of this stage. I.e. that each package/phase needs to be adjusted and tested thoroughly. Once all packages/phases are live, the HIS implementation is finished, but this does not mark the end of the project (Umble et al., 2003).

### **4.3. Stage three: Evaluating the project**

After completing the implementation, the project should be evaluated and reviewed to make sure it is compliant with the requirements which were set at the beginning of the project. After the initial implementation, the system should be able to adapt to a changing environment. Meaning that it needs to be improved continually, it needs to be able to be updated in order to meet new demands (Chang et al., 2015; Gärtner & Kuttner, 2016).

An organization can only take in a certain amount of change during a certain period of time (Umble et al., 2003). Umble et al. (2003) propose that the project group should conduct a post-implementation evaluation several months after the system went live. For example, a post-implementation audit in which departments are checked whether they need additional assistance or not (Umble et al., 2003). They also emphasized the need of a continuous support of the management. However, also during the implementation project the progress should be evaluated. This will make later adaptations to the system to be easier to carry out.

### **4.4. Employee engagement**

During all three stages, it is important to provide information to the employees and users as early as the planning phase and then continue with informing them. Neglecting employee engagement can result in employee resistance towards the project and the system. Therefore, when providing information to the employees early and at a regular basis, employees feel more engaged with the project and are more acceptant towards it. When employees receive information about the new system at an early stage, it is easier for them to anticipate and adapt to upcoming changes (Elving, 2005). Employee engagement will also encourage participation in training moments, which will also lead to a higher acceptance of the project as a whole. Employees who feel disconnected from the project can cause damage to the project, meaning they are more actively protesting the project and the new system in comparison to employees who are acceptant towards it (Chang et al., 2015; Gärtner & Kuttner, 2016).



## **5. Procedure evaluation**

In order to evaluate and validate the stages and steps, which were explained in section 4, three case studies were conducted in which three in-depth interviews were done. Any quotes that will be used from these interviews will only have masculine pronouns, in order to ensure the anonymity of the respondents. In this section, the question structure of the interview protocol (Appendix A) is followed.

### **5.1. Case descriptions**

Based on data published on 12<sup>th</sup> of February 2019 by the Belgian Federal Public Service of Health, the sizes of these hospitals can be determined. Out of the three hospitals, one hospital is considered a middle-sized one, the other two are considered to be a small hospital (Agency of Care and Health, 2019).

Hospital A is considered to be a middle-sized hospital (Agency of Care and Health, 2019). The IT director that was interviewed is enrolled at the hospital for over three years with 18 years of experience in the healthcare sector. Hospital A used to have several different systems from several different suppliers. In 2016, it was decided that they would invest in a new and hospital-wide system. As of October 2019, the first part of the system was launched which was the patient Admission, Discharge, and Transfer system (ADT) together with the appointment management. The second part will follow at the beginning of 2020 where the two parts will also be integrated into one unified system.

Hospital B is considered to be a small sized hospital (Agency of Care and Health, 2019). The IT director of hospital B started his professional career at the current hospital and now has over 30 years of experience. Between 2000 and 2018, this hospital had several systems from several suppliers running at the same time. Early 2018, they signed a contract with a supplier of a HIS in order to have one, global system which can be used at both their campuses. The implementation started in 2019, and the whole system should be integrated and running in 2023.

Hospital C is also considered as a small sized hospital (Agency of Care and Health, 2019). The IT director has over 16 years of experience in the healthcare sector, with 13 years at the current hospital. Similar to the other two hospital, hospital C has had several different systems from several different suppliers. In 2017 they decided to invest in a new, integrated HIS. As of 2019, the first part of the system has been launched, with the goal of the system being completely implemented in the beginning of 2022.

### **5.2. Results**

This subchapter is divided into the current procedure the hospital is following and a comparison with the proposed implementation procedure from section 4. The first part describes the comments of the IT directors concerning the open question about how they managed the implementation of the new Hospital Information System (HIS). In the second part, the results are shown concerning the questions surrounding the implementation procedures described in chapter 4 of this research.



### **5.2.1. Current procedure**

Looking at the general procedure these hospitals followed during the implementation of their new HIS, it can be seen that all three hospital, approximately, follow(ed) the same steps towards the implementation.

According to the respondents, the reason for investing in a new HIS started with the Belgian government stimulating hospitals to invest in a new holistic HIS by providing grants. The respondent from Hospital A commented that “[...] the government stimulates us to go to a global system and subsidises us for it. For us this means that a lot of links between different systems becomes one global system”. The three respondents mentioned that the new system needs to replace the current separate systems, into one unified system.

Once the decision was made to invest in a new HIS, the three hospitals started forming a project group, composed out of several key users, which would manage the implementation. The project group then needed to choose a supplier which will provide the HIS software. This decision was based on several criteria such as “[...] working with a supplier who offers a hosting structure where no physical databases needs to be installed at the hospital with the implementation of the new HIS”. “[...] letting key users of different departments rank the different suppliers, in order to choose the best ranked one”.

Together with the project team and the supplier, the required resources, such as financial and human resources, were discussed in order for the system to be implemented. Hospital C commented “[...] Together with the supplier, we made a tender in which all required resources were found in order for the hospital to be able to complete the project. This would mention technological resources, financial resources, human resources”. When the resources are determined, the project group would define a plan of implementation. Once the plan is defined, the implementation of the system can start followed with training the employees, to eventually the full launch of the system.

### **5.2.2. Compared to proposed implementation procedure**

Responding to the more in-depth questions concerning the steps described in chapter 4, the follow results were found. The questions were covering the steps of the procedure accordingly.

#### ***Planning stage***

Regarding the project management group and how this group was formed, the three respondents mentioned they had a group managing the project. The difference was found in how the members of these groups were selected. Besides themselves, common members which each respondent mentioned were the managing director, the program manager, the quality manager and the director of nursing. Additional to these board members, certain key users would be part of the group as well: a representative of the doctors as well as a representative from pharmacy. Concerning the selection procedure of these members, a respondent commented: “[...] it is important to have all these board members in the project group, that way the group has the highest possible decision-making mandate. A project group without would mean that all meetings need to be approved which would slow down the project significantly”. Alongside the board members in the project group, non-board members were selected based on their expertise, their knowledge, their experience. A respondent mentioned

that “[...] these were people from the core business, people who have some IT affinity”. According to the respondents, the project group was supplemented with some external members provided by the supplier, based on the available resources. “[...] the meetings were expanded with people from the supplier, these were the program manager and the project manager from our supplier”, these externals help to guide the project and guide the implementation. However, hospital C stated that these externals only partly guided the implementation stage in order to reduce costs: “[...] the supplier does the accompaniment of the implementation for a part, let us say 30-40% they will guide us. But the other 60-70% we do ourselves, without guidance from the supplier”.

Concerning the objectives the HIS should achieve as well as the plan for implementing the system, the respondents’ responses were similar. The respondents all mentioned that the new system needs to have a long-term vision, it needed to be future proof. A second important requirement the respondents recalled was that the new system would need to be conform with the necessary requirements set by the government in order to receive a government grant. The most emphasized response from the respondents was that the new system needs to replace the old systems into one, global system. A respondent included: “[...] with the new system we want to make procedures more efficient and faster. We do not necessarily want to win time at the source of a procedure, but rather win time in the whole workflow. We want our employees to be less behind a computer, and more at the bed of the patient”. In order to make sure these objectives are achieved, respondents mentioned the construction of a detailed timeline or determining certain deadlines, in agreement with the supplier, when certain components need to be implemented, when training should start, when the system should be launched.

In order to reach these objectives, the project management groups draft a plan to implement the new HIS. Respondent A explained that their plan was developed based on a template which the supplier delivered. However, “[...] this was an implementation plan of a product that has actually never been done before, so a rather difficult exercise”. The other respondents explained that they developed the specifications together with the supplier. These specifications covered the required resources for the implementation such as financial resources, human resources, technological resources. Regarding potential inadequate resources, respondent B answered “[...] after the feasibility study, it was clear that we lacked human resources. Not only meaning that we would need more manpower for the implementation, but also the general knowledge of our employees, we would need to educate them, train them”. According to the respondents, technological resources are rarely inadequate as computers and other electronics require frequent updates throughout the years anyways.

The implementation plan would also describe how the system would be implemented, what implementation strategy would be used. All three respondents explained that they, after consultation with the supplier, used a phased implementation strategy rather than a big bang implementation strategy. “[...] I think it is more realistic to work with more smaller steps than one big step. But both strategies have their pros and cons, it just depends if your whole organisation is behind the strategy or not”. Respondent B commented that he would rather use a big bang implementation, but using a phased implementation is more realistic “[...] with a phased implementation, the tension on the departments is longer. Both strategies have their pros and cons, but for me there are more pro’s

than cons with a big bang. The big con of a phased strategy is that employees of a department that still works with the old system during the implementation stage will need to check, depending on the service, whether they need to use the old or the new system. However, a con of using a big bang would be that we would need to hire 27 additional employees to cover the workload. Financially, this is not possible". Respondent A also mentioned the financial part of a big bang implementation "[...] for a big bang to work, you need a lot of 'application people' during the start-up. Depending on the size of the hospital, this could be around 100 to 200 people. Financially this is unrealistic, it too much money in such a short time".

When asking about the design of the HIS and their involvement in the design, the reactions were rather negative as the hospitals had no real input in the design. The system is as the supplier delivers it, with the exception of small configurational changes. "[...] you are able the change some parameters such as our own templates, but the system itself is how it is". However, the supplier does try to meet with their customers' demands, meaning that they will investigate the requests if it is applicable to all their customers before developing it. "[...] our supplier has a committee with all the program managers of their customers. In this committee, possible updates or points of improvements will be discussed". When it comes to the involvement of the employees, the respondents mentioned they have limited involvement. "[...] employees have little involvement, the only involvement with the design is with the layout of the dashboard. With this I mean that the system has the 'look' and the 'feel' of our hospital, even this small involvement is a confidence boost for our employees".

Following up on the user involvement, which concerns about employees being able to give ideas for the development of the system, as well as how employees were informed about the new project. The respondents mentioned the use of an information campaign. "[...] We organised an information campaign with several information moments during meetings where we presented the project", "[...] there were certain information moments during lunch and in the evening where we explained what the new system is, as well to show them 'what's in it for me?'. This was an important step in order to take away part of the fear of something new". The education of the users did differ between the hospitals. Two respondents stated that they started educating users as soon as possible as this was one of the most important and expensive parts of the project. Respondent A said that "[...] education was seen as the biggest resource consumer of the project. We put educational video online, we handed out instructions. But the most important one would be the classroom training, there will be around 40 sessions per department", respondent B mentioned that "[...] The difficult part is to make sure all users receive training, this includes the doctors which are the most difficult group to mobilize. That is why we try to organize additional session for users who have missed previous ones". Hospital C had a different educational plan, educating the users was done later, in comparison with the other hospitals. They wait until the testing of the system is done, before they start with educating the users. "[...] for every part we implement, we are going to have specific training moments for the specific target audience meaning the department in which the system is being implemented. This training is mostly classroom training in smaller groups of around 10 people. Users will first receive theory about using the system and then they will also need to make exercises by themselves. Doctors will receive the same training, only at a different time that fits for them".

### **Implementation stage**

Starting the second stage, the first step would be concerning the organisational structure procedures which needed to be adapted to the HIS or vice versa. Two respondents commented that the main structure of the organisation would need very little change. "[...] on the operations, I expect an improvement. The processes the employees need to follow stays the same, the system will make everything more efficient, making more time for the employees to be at the bed of the patient instead of behind a computer", "[...] we had to make some small adjustment to certain processes, but the core of the process did stay the same". The three respondents mentioned that they did not agree with adapting the organisational structure to the HIS, as the majority of the time the HIS should be adjusted to the organisational structure. Respondent from hospital C mentioned that certain processes needed to be changed a little in order to be conform with the new system, which not only is a very difficult task to do, he also mentioned the difficulty of addressing the employees that their way of working will change. "[...] most of the time, change will result in resistance. That is why it is really important to guide the employees, to show them that the new way of working might even be better than the previous way". The other two respondents agreed concerning the importance of guiding the employees, when there is a change. Even if the changes are small, i.e. using a different software or a different user interface, neglecting change management can result in resistance.

As hospital B has not reached to testing phase, the respondent mentioned the test phase of their previous electronic health record (EHR) system which was launched in 2013. "[...] with our previous EHR, our supplier did not intervene with the testing phase. The test of the system that was going to be implemented was done by our application manager. Once he finished the test, it would be tested again by the key users of the several departments for around three months. Only after these tests, the system would be a 'go' or a 'no-go'". The other two hospitals had already done tests for at least one of the projected HIS modules. Similar to hospital B in 2013, the testing phase happened in two phases. First the system that would be implemented is tested by the application manager together with a team from the supplier. In the second phase the system would be tested for a second time by the key users of the specific department. "[...] the tests are done by using several cases with scenario's in order to validate the system. However, we do know that for certain parts we can only do the validation after the launch". The respondent from hospital C mentioned again that the supplier will only help with testing for 30%-40% of the cycle. "[...] For example, if we would implement it in 10 departments, our supplier will guide the tests for the first three, the seven other departments would be tested by us alone".

All three respondents expressed the importance of the testing phase, "[...] it is important that all components, all configurations are tested and validated thoroughly by both the application manager and the key end users". Respondents also mentioned that the tests unveiled several required changes "[...] some things needed to be changed, most of the time these were certain things that were annoying or blocking for the users when using the system". "[...] I remember that the first test was really important, the testing took around three months. After the testing, the implementation was stopped for a few additional months in order to make the required changes".

### ***Evaluation stage***

After the system was tested and was launched, the respondents mentioned aspects of a certain evaluation of the implemented part. "[...] After the implementation of the first module, we conducted an evaluation together with all the end users. We learned a lot from this evaluation, things that we had done right or wrong. We will use this information for the implementation of the next part". After the evaluation, the respondents mentioned that the part that was implemented mostly met the requirements. "[...] after the evaluation we did miss a few things, but grosso modo I was satisfied". "[...] there were extremely high expectations for the new system of which I knew were not feasible. These expectations were set by our previous board of directors, by people who are not here anymore. Personally, I was satisfied the system that was implemented, as I knew before that the expectation could not be granted". Respondent B also emphasized on the importance of keeping the project group together, even after the system is fully implemented. "[...] the project group will not be as active as it is today but will still be there for example to make decisions concerning certain updates".

While on the subject of updates, the respondents mentioned that the system needs to be flexible enough to respond to updates. Updates seem to be necessary in order for the system to keep evolving, so it keeps up-to-date with the basic requirements of the sector. However, the system was flexible to updates in a sense that the updates were for all the customers of the supplier. "[...] as an individual hospital, you need to be aware that certain changes will only happen if there is a benefit for the sector". "[...] as the supplier has multiple customers, it is difficult to get smaller changes on the table. So, you will have to wait a long time to get that realised".

### ***Employee engagement***

When asked about employee engagement, the respondents mainly repeated that the employees had little involvement but were informed a lot. Respondent C mentioned that they tried to involve the employees through representation in the project team "[...] the project team is considered to be a reflection of the organisation. All divisions and departments should be represented as good as possible in the project team". Concerning the communication with the employees, the three respondents did mention that they tried communicating the project with their employees as much as possible and necessary. Answering the question about when the employees were first informed about the project, respondent C said "[...] this happened from the moment we made the decision that we wanted a new HIS. From that moment the employees were taken on board. We immediately knew, that is what we are going for, those are the goals. This is how the project will look like, this is how we will make decisions". Concerning the frequency, the employees were informed about the project and its progress, it seems that the respondents agree that it is very important to communicate with your employees, that you do not exclude them. However, it is important that when you communicate, you live up to what you communicate. "[...] there is a trade-off. If you communicate a lot, you need to make sure you come through with what you say". "[...] as soon as we know 'this will happen', we will inform the employees. There is no point in saying every month 'it is not there yet'", "[...] informing too much is also not good, but you need to make sure that you keep everyone on-board".

Keeping your employees on-board is extremely important according to respondent C "[...] I think that it influences the chance of success of the project. If there is no trust in the project, I do not think it will succeed". The three respondents acknowledged that during the project, most of their

employees were motivated and trusted the project. However, it seems that there will always be some people who are less motivated. Especially at the start employees would resist the project, as they do not understand what will happen. Employees are scared for the changes to come, they are scared that they will need to change their way of working. “[...] initially there was some resistance, but we try to provide the best possible guidance through change management”, “[...] having the trust of your employees is very important. That is why we really focused on keeping that trust by visiting every department during the launch day and listening to the employees, helping them”.

### **5.2.3. Interview ending**

At the end of the interview, the respondents had the chance to indicate what they consider to be the main challenges and/or problems during the implementation process and if they would do certain things different.

The biggest challenge for respondent A is that the supplier’s staff is still young and inexperienced, they would sometimes come over as unprofessional. “[...] the employees of the supplier were still young, or not skilled enough to implement a HIS in a hospital. It felt like those people were not on the right level. That is why the supplier tried to attract extra competent people over the first few months”. In response to what respondent A would do differently when implementing the next step, he explained he would focus more on involving more people with the project. “[...] involving more people will always pay off, and that is something we will need to do more”. He also shortly mentioned that they would also need to focus more on change management and convincing people that the changes are something good. “[...] Some working methods are so ingrained that the employees expect that the new system will need to be adjusted to them, and not the other way around. That is something you do not want to happen”.

Respondent B mentioned that something he wants to do different and put more focus on is education. Not only concerning the labour intensity of the training campaigns, but also focus on the registration of people who have done the education, what education they have followed, when they followed it. “[...] With the nursing staff, it is rather easy to get them together during the shift change. After their shift you can keep them a bit longer for the training moments. The hardest group are the doctors. They have consultations, some doctors until eight o’clock in the evening, some doctors only come to the hospital at certain days, doctors might get an urgent call during a lesson. That is still something that I will need to find a solution for”. Another challenge which was mentioned is to make sure there is a decision-making authority within the project group, otherwise you will have several meetings about a subject without any progression.

Respondent C mentioned two major challenges on which he wants to focus more during the next part of the project. First, he stresses the importance of having the right resources “[...] having the right resources at a financial level, as well on human level is a challenge. Making sure you have the right people on board, having the right people in the project team, making sure that enough time is spent on the project”. A second challenge is change management, guiding people, helping them getting through the changes. “[...] telling people, who have worked a certain way for 20 years, you need to do it different now. That guidance is the most difficult part. But you also need to make sure

that the right information is available at the right time, for the right person. That is a difficult part of change management”.

## 6. Discussion

Implementing an Hospital Information System (HIS) in hospitals brings forth several challenges and factors which affect the implementation process such as human factors, managerial and organization factors, and technological factors. These challenges can be covered by having a solid project management, an implementation plan which clearly states a clear vision about the objectives of the system. As these systems are rather new, literature lacks an implementation procedure specifically for a HIS implementation. Therefore, developing such an implementation procedure will facilitate the implementation of a HIS in hospitals.

This study developed a HIS implementation procedure based on process models for enterprise resource planning (ERP) systems found in the literature. The ERP process models were altered to a HIS process model based on factors which influence the implementation of hospital systems which were found in the literature. The procedure was validated using in-depth interviews with hospitals, in which the steps of the newly developed procedure were checked. Based on these interviews, the steps of the procedure, found in section 4, were validated by the respondents. Suggesting that each of the given steps were steps that they would have done, or which needed to be focused on based on their experiences.

Concerning the planning stage, the respondents agreed with the four given steps. They mentioned the composition of a project team which monitors the whole project. How the members of this project team were selected. However, respondents did mention that beside the members who were selected based on their skills, additional members are selected ex officio in order to have a decision-making mandate. The next step will set the objectives of the project, the most emphasized response was the need of a unified, global system. These objectives will need to be translated into a project plan, which not only should contain a timeline but also should contain the required resources that are needed. The respondents also mentioned that the implementation strategy is already defined during this step, rather than during step 1 of the implementation stage, subsection 4.2. Defining the implementation strategy should not be considered a separate step and should be done during the planning stage of the process. This is contradicting with the view of Gärtner & Kuttner (2016) who see this as a separate step, part of the implantation stage. Concerning the involvement in the system design, the respondents mentioned that there was very limited involvement. The system has to be taken as it is delivered. However, the supplier does try to meet with the customers' demands, if these are reachable. The respondents did suggest making a separate step for the organizational learning as they consider the education of the employees as one of the most important steps in such a project.

The implementation stage will have three steps, instead of five as the first step of the literature-based procedure, 'determining implementation strategy', was removed as explained in the previous paragraph. Therefore, step 1 starts with the adaptation of the HIS to the organizational structure. The respondents agreed that it is important that there is a balance between adapting the HIS to the organizational structure as well as adapting the organizational structure to the HIS. However, the respondents stated that changing the organizational structure should only be done when it is really necessary. Even when it is necessary, these changes should be minor changes as changing the organizational structure and processes is very difficult and will result in resistance from the



employees. Therefore, step one changed to 'Adaptation of the HIS to the organizational structure', without focusing on the other way around. In step 2, the respondents emphasized the importance of testing these adaptations and the HIS in general. When testing happens thoroughly, less problems will occur both before and after the launch, which means more trust of the employees in adopting the new HIS once it is launched, as stated by Shaul & Tauber (2012). After testing, encountered problems should be resolved and potential further adaptations to the HIS should be done. These new adaptations should be tested again until no more problems are encountered. Therefore, this can be seen as a loop-effect going from step 2, back to step 1 until the HIS is ready to be launched in step 3. Once the new information system is in use, respondents made clear that the project is not finished. It is important that the project team stays operational, even after the launch of the system. Especially for future system updates and evaluations in order to meet to the basic requirements of a hospital, to make sure the system to be future proof.

In regard to informing the employees, it is clear that the respondents emphasized on the importance of having a detailed change management plan. As the trust of the employees can make or break a project, gaining the employees' trust starts with change management and open communication with the employees. In alignment with Elvin (2005) and Farzandipur et al. (2016), in order for a HIS implementation to be successful, the employees' fear of not knowing what is going to happen needs to be controlled by communicating.

Figure 3 shows an adapted visual model of the procedure after the results of section 5.

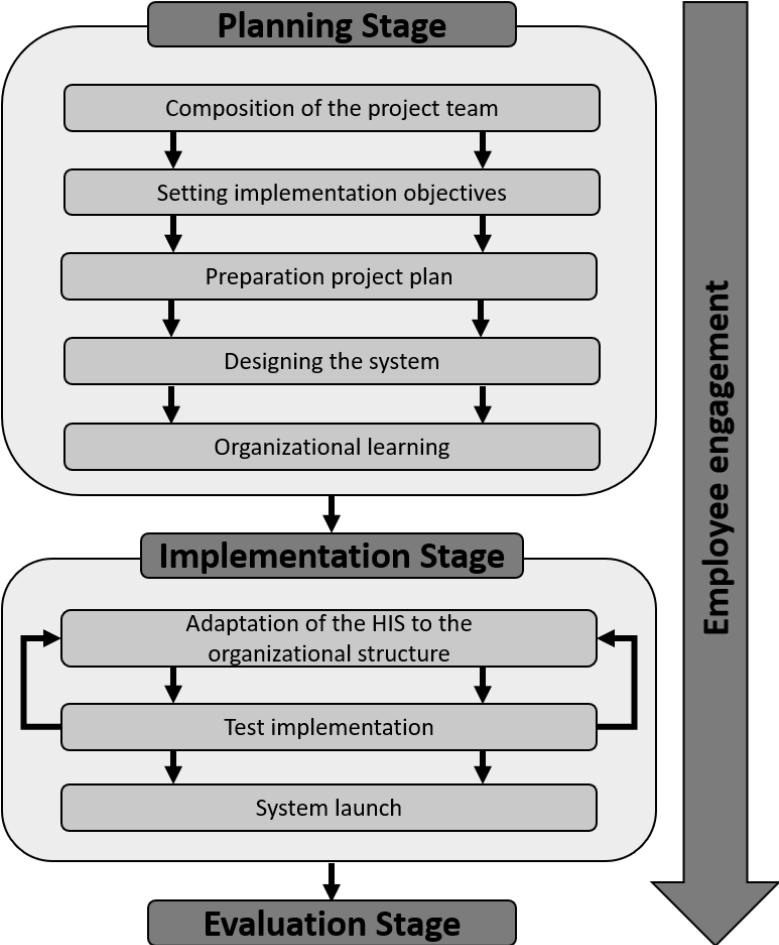


Figure 3: HIS implementation procedure model

With this implementation procedure in mind, hospitals can start their HIS implementation project without forgetting any steps, in an effort to increase the likelihood of a successful HIS implementation.



## 7. Conclusion

The goal of this study was to develop an implementation procedure which support hospitals with the implementation of a Hospital Information System (HIS). Before the procedure was developed, literature was consulted in order to identify factors influencing the implementation of a HIS. Then in order to develop the procedure, a literature study was conducted to identify important steps to implement an Enterprise Resource Planning system (ERP), as literature did not provide this for a HIS implementation. With this information, a literature-based procedure was developed. The procedure exists out of three stages, with each stage having their own steps. The first stage is the planning stage, in which five steps help to interpret how to plan such a HIS implementation project. The second stage concerns the implementation stage. In four steps, the procedure guides how to implement the system until it is launched. The third stage is known as the evaluation stage in which the newly implemented system will be evaluated, as well as future evaluations of possible changes or updates. Throughout the entire project, employee engagement is crucial as informing employees regularly about the project will increase their trust in the project, which will increase the likelihood of a successful HIS implementation. To validate this developed procedure, three case studies were performed in which in-depth interviews took place. This resulted with the views and experiences from domain experts in hospitals. Based on the case studies, the implementation process procedure was confirmed.

As only one interview was done in each of the three case studies, this could be seen as a limitation of this research as well as only focusing on interviewing domain experts in hospitals rather than also interviewing domain experts of HIS suppliers. However, this kind of data collection was chosen purposefully in order to collect more in-depth information. The geographical scope was also rather limited as the three hospitals were located in Belgium. Also due to time constraint, it was not possible to observe the complete implementation cycle of the implementation of a HIS.

Therefore, in future research, conducting a 'before-and-after study' could gain a more detailed insight of a newly implemented HIS, as none of the three hospital had fully completed their HIS implementation project. Future research could also expand its geographical range, in order to have a larger geographical scope and to increase the generalizability of the study, e.g. doing research on the impact of different cultures during a HIS implementation. Besides focussing on interviewing hospitals, interviewing the suppliers of these systems could also be a great source of information. In addition, it can also be interesting to investigate each step in more detail. For example, how should members of the project team be selected, which implementation strategy should be used, how to optimize organizational learning, what ways are the best to test the system, which tests can be done before launch, how to guide the launch of such a project. With this information, the implementation process would be supported even better and in more detail.



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## 9. Appendices

### 9.1. Appendix A: Interview Protocol

#### What, why and how

The purpose of the interviews is to examine whether the problems for the implementation of a hospital information system, which were found in the literature, were applicable during the implementation of the HIS of the participant. And if the synthesis of the HIS implementation plan would cover these problems. Providing the participants with this list of questions, based on these themes, before the interview itself should make them able to prepare themselves for the questions to come (Saunders et al., 2016; Yin, 2014).

The reason why interviews were chosen for the data gathering is because of the ability of interviews providing a more detailed explanation from the participants in comparison with other data collection methods such as questionnaires. Also, the number of participants of this kind of in-depth interviews will be smaller in comparison with other methods, especially because of the smaller target group of hospitals in Belgium.

The interviews will follow a semi-structured format, which means that the interviewer has a guideline which needs to be followed in order to cover the key topics during the interview. This format also allows for additional questions to arise, as the participant is able to elaborate on certain questions. In consensus with the participant, the interview would be recorded, and the interviewer will take notes in order to do a thorough analysis of the interview afterwards.

#### Interview questions

As stated in the methodology, a semi-structured style of interviewing will be used. This means that the questions, which are listed below, act as a guideline to make sure all the topics, that are needed to be addressed, are addressed. Based on the flow of the interview, the interviewer can ask certain follow-up questions in order to get a more detailed view. Some questions in the list contain potential follow-up questions which could be asked, these are highlighted in *italics*.

#### Protocol

##### Hospital information system implementation interview protocol

Institution: UHasselt

Interviewee (Title and Name):

Date:

Interviewer: Arno Dops

### ***Introductory protocol***

In order to make my note-taking easier, I would like to record our conversation. This recording will be transcribed and afterwards it will be destroyed. Only researchers of the project will be able to look at the transcriptions. For your information:

1. All the gathered information will be held strictly confidential, unless said otherwise
2. The participation of this interview is completely voluntary, and the participant may stop at any time
3. The interviewer will not intend to inflict any harm

Can the name of the hospital be used in the dissertation and the potential scientific publication that results from this? If not, the term "a Flemish hospital" will be used. (Yes / No)

*Signature participant:*

### ***Introduction***

You were invited to this interview in order to answer some questions concerning the implementation of an hospital information system. The goal of this research is to look at the barriers of such an implementation and if these can be avoided using an implementation model.

### ***Questions***

#### **Participant background**

- How long have you been in this position?
- How long have you been at this hospital?

#### **Questions**

##### Planning stage:

- Was a certain team/group formed in order to lead the project?
  - *How was this team formed?*
- How were the members elected? (Key users of the involved departments?)
  - *Were there some kind of criteria they needed to adhere to? (Professional qualifications, work experience, process knowledge, IT affinity, team spirit)*
  - *Were there any external consultants?*
- Were there any objectives described which the HIS implementation should meet?
- Was there a certain 'main' plan for the whole project, or was it more step after step?
- Did a feasibility study occur?
  - *Were there any resources lacking? (Human, technological or business resources)*
    - *Was there a lack of general knowledge and skills to use the new HIS?*
- How did the 'design' of the system come about?
  - *Who was involved in designing the system?*
    - *Were the users involved in the designing of the system?*
- How were the users informed on how to use the new system?

- *Did you organize certain training moments?*
  - *Did the employees find it difficult to learn and use the system?*

#### Implementation stage:

- Was there a certain implementation strategy planned?
  - *Big bang strategy? Phased/Gradual strategy?*
  - *What was the reason you chose that specific strategy?*
- How did you adapt the organization in order for the HIS to work?
  - *Did you need to adapt the organizational structure to the HIS or vice versa?*
  - *Maybe you did not need to change anything because of the previous system?*
- Was there some sort of testing phase?
  - *How was the new HIS tested?*
  - *What did you learn from the testing?*
- Were there any adaptations needed after the testing phase?

#### Evaluating stage

- After the system went live, did the project stop?
  - *Was the project evaluated and reviewed after the go-live?*
- Were the HIS requirements met?
- Is it possible for the system to respond to changes? Update?

#### Employee engagement:

- How were the employees involved in the project?
  - *When were the employees informed about the project?*
  - *How often were the employees updated about the project?*
- Were the employees motivated about the new HIS?
  - *Did they trust the project?*
  - *Is employees' trust in the project of importance?*

#### General:

- What are the main problems / challenges that came up during the implementation process (in each phase)?
- Was it easy to work with the firm who supplied and made the HIS?
  - *Was it possible to make changes in the design?*
- Was it difficult to make a uniform system for all the different departments?

#### **Ending**

Thank you for your time and your insights on the questions surrounding this topic. If I have some queries or encounter some uncertainties, you can contact me through e-mail. If you are interested to see the end result, I could send you a copy of the research once it is completed.