Healthcare Information Systems Assimilation: The Malaysian Experience

A thesis submitted in fulfilment of the requirements for the degree of Doctor of Philosophy

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Declaration

I certify that:

- except where due acknowledgement has been made, this work is that of the author alone;

- this work has not been submitted previously, in whole or in part, to qualify for any other academic award;

- the content of this thesis is the result of work which has been carried out since the official commencement date of the approved research program;

- any editorial assistance carried out by a third party is acknowledged.

Hidayah Sulaiman

July 2011
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Abstract
The importance of information systems/information technology (IS/IT) to healthcare organisations today is being recognised as paramount and significant. Due to the exponentially increasing healthcare costs and the trend globally of having IS/IT as a solution to assist clinicians’ work processes, it is critical to ensure that the introduction and deployment of IS/IT innovations to any healthcare organisation is done efficiently and in a systematic manner. Hence, successful assimilation of IS/IT which is the central focus of this research becomes a key consideration. The assimilation of healthcare information systems (HIS) in hospitals refers to the extent to which the HIS are being used within and/or to enable key processes and activities in the healthcare organisation. Special attention in this study is given to the different stages of assimilation including initiation, adoption and routinization.

This research is qualitative, adopting an exemplar single case study approach with more than one unit of analysis embedded within the case. This research also takes an interpretivist view with the aim of developing concepts, confirming or refuting theory, drawing from specific implications and the contribution of rich insights. A public hospital in Malaysia currently operating with an end-to-end hospital IS/IT was selected as the case to explore the key elements that contribute to the success of assimilating HIS. The conceptual model of this research was built from the concepts of innovation assimilation theories, technology-organisation-environment framework and resource based view of the firm. Thematic analysis and coding strategies were adopted to analyse transcriptions of interview data to identify expected findings, emerging themes and significant findings.

The key findings from this research indicate that there are people, process, technology and environment elements that should be considered as facilitators to HIS assimilation success, as well barriers that the healthcare organisation should overcome throughout the entire assimilation stages or at specific stages. This research is therefore not only topical but especially beneficial to all players in the web of healthcare as they grapple with trying to overcome barriers in successfully assimilating HIS. This research also provides a contribution to the innovation assimilation body of knowledge and elaborates upon the
important elements to consider by healthcare organisations when they try to assimilate HIS.
CHAPTER 1

1 Introduction

Over the years, various innovations have been introduced into healthcare organisations in order to incorporate better use of technology, to aid decision making, and to facilitate the search for medical solutions. This allows integration between experts in the medical field either throughout the organisation or globally (Fadlalla & Wickramasinghe 2004). Innovations such as Electronic Health Record (EHR), Hospital Information System and Telemedicine will generally bring about the usage of information systems as a means to provide better health services for the community and overcome challenges that have been perceived as cumbersome for people seeking medical treatment (Jha et al. 2008). Nevertheless, these innovations have not escaped from various challenges and issues both from internal and external factors (Wager, Lee & Glaser 2005). The main aim is to eliminate manual processes that are now seen as a major hindrance to increasing organisational performance in terms of providing fast and efficient health services. The assimilation and use of information systems and information technology (IS/IT) has an important role in enhancing firm performance (Devaraj & Kohli 2003). Assimilation can be defined as the extent of which IS/IT are being used within the key processes and activities in an organisation. The stages of assimilation begin from the organisation’s initial evaluation to its formal adoption and ending with a well-accepted deployment of the system to a point where it becomes part of the value chain activities in the organisation (Cooper & Zmud 1990; Fichman 2000; Setia et al. 2011). The final stage where the system becomes part of the organisation’s value chain activities is known as routinization (Zhu, Kraemer & Xu 2006).

This thesis sets out to examine the important issues on the assimilation of healthcare information systems (HIS) in public hospitals. A Malaysian public hospital equipped with an HIS was chosen as the case study for this research to uncover the issues with regards to the assimilation of HIS. Although the term HIS may sometimes be used interchangeably for hospital information system or healthcare information system (Ozkan, Byakal & Sincan 2008), this research defines HIS as a healthcare information system that integrates computer systems throughout the hospital which was developed to
enhance the clinical and administrative function of a hospital (Kim, Lee & Kim 2002). The HIS applications are also developed to communicate with the relevant medical departments at the Health Ministry especially in regards to human resources, finance and procurement.

The following sections and chapters describe the issues through presentation of results in an exemplar case study. The case study explores the technology innovation assimilation issues that too many hospitals are facing in the acquisition and deployment of HIS (Chin 2007; Reardon & Davidson 2007; Setia et al. 2011; Thakur, Hsu & Fontenot 2011).

Through the development of a focused theory on innovation assimilation (Fichman 2000, Fichman & Kemerer 1999), technology-organisation-environment (Tornatzky & Fleischer 1990) and resource based view of the firm (Bharadwaj 2000; Grant 1991, 1995; Huang et al. 2006; Khatri 2006; Ross, Beath & Goodhue 1996); it was possible to provide a technology assimilation model for Information Technology (IT) managers, hospital chief information officers and IT executives involved in acquiring or deploying HIS. Combination of these theories was tailored specifically to the technology implemented in this healthcare setting, aimed at delivering better healthcare services. Upon completion of the research data analysis phase, the HIS assimilation model was further refined.

To understand the purpose, aims and significance of this research, this chapter is organized in 4 main sections, describing the background of this research (Section 1.1), context of this research (Section 1.2), objective of this research and the research questions (Section 1.3), significance of this research (Section 1.4) and finally the outline of this thesis (Section 1.5).

1.1 Background

The healthcare industry has been criticized for being slow in the adoption of technology to support delivery of care (Barnes 2001; Spil & Stegwee 2001; Suomi 2001; Wager, Lee & Glaser 2005; Wickramasinghe 2000). Various innovative technologies have successfully been introduced with the aim of improving hospitals' performance and providing better healthcare services. Various research indicate that the delivery of these technologies is perceived to be less than appropriate or adequate for the medical staff.
The introduction of new technology begins with great enthusiasm and an extensive spread of initial excitement about the acquisition. However, the new technology fails to be deployed and sustained in many acquiring firms due to not meeting specific user requirements or too complicated to be used by the users (Fichman & Kemerer 1999). This then causes the existence of an assimilation gap for a technology innovation as the initial acquisition of the technology does not always lead to sustained use of the technology (Fichman & Kemerer 1999).

Previous literature on technology innovation and diffusion was mostly based on the work of Rogers (1983) through the diffusion of innovation (DOI) theory (Agarwal, Tanniru & Wilemon 1997; Ahmed, Daim & Basoglu 2007; Burke et al. 2002; Gallivan 2001; Greenhalgh et al. 2004). The diffusion of innovation model by Rogers (1983) has been extended (Moore & Benbasat 1991) and has created an insightful role in moulding the concepts, terminologies and scope of the innovation field. Nevertheless the extended models are not always suitable for different innovations at different adoption context (Fichman 2000).

In a more recent diffusion of innovation article by Rogers (2003a), it was suggested that innovations in the non-profit sector often encounter huge diffusion difficulties especially with innovations that could provide benefit to the public. Hence a study that explores innovation issues is worth undertaking (Mcgrath & Zell 2001). A study that examines the organisation, people and technological level focusing on how technology can be sustained throughout the innovation assimilation stages is also deemed important. This study serves to fill a key void in the existing literature through the exploration of “how” and “why” people in the organisation reject or refuse to make use of a specific innovation after the acquisition process, which can ultimately cause discontinuance of the innovation (Greenhalgh et al. 2004). There is also a lack of theories being developed for a specific type of technology and for a particular adoption context such as the healthcare organisation due to the lack of generic theory of technology innovation (Fichman 2000). These factors together provide the motivation for this research in developing a technology innovation assimilation model for hospitals to successfully assimilate their healthcare information systems (HIS). Successfully assimilating HIS is also seen as having a possible impact on decreasing technology, organisation, environment and
process issues pertaining to acquisition and deployment. As a result, successful assimilation of HIS would realize the objective of assisting work processes of the medical professionals to the benefit of the community at large.

1.2 Context

The context of this research is a Malaysian public hospital assimilating HIS with both clinical and non-clinical information systems communicating with relevant medical departments at the Health Ministry. This research will provide a specific focus on HIS that covers all aspects of the hospital workflow-including both clinical and non-clinical applications such as patient registration, diagnostics, pathology, wards, outpatient clinics, billing, procurement and human resource applications.

Malaysia is an example of a developing country that is progressing in its E-health initiative by having the healthcare IS/IT initiative placed under the government’s vision 2020 plan (Mohan & Raja Yaacob 2004; Sibte et al. 1998). The healthcare reform initiative known as the Telemedicine Blueprint under the Multimedia Super Corridor (MSC) Telehealth project has been launched since 1997 to reform the Malaysian healthcare system (Sibte et al. 1998). There are currently 3,616 government health facilities inclusive of 135 public hospitals in Malaysia having more than 32,000 beds, 2,813 rural clinics and 668 government dental clinics (MOH-Malaysia 2010). Out of these facilities, only 18 public hospitals are referral hospitals equipped with either fully integrated or partially integrated HIS since the Telehealth initiative was launched more than a decade ago (Li, J 2010). Patients with critical cases are mostly referred to these 18 fully or partially HIS equipped hospitals by other public hospitals and some private hospitals due to resource availability in terms of medical specialists and equipment. This indicates the criticality of IS/IT efficiency in these facilities, especially in catering for the enormous amount of critical cases daily for patients who seek treatment from all over the nation. It is especially important for the HIS equipped public hospitals to perform efficiently whilst providing excellent services to the public as the revenues from general taxation was used to subsidize health services namely in purchasing the systems and state-of-the-art equipment (Chee & Barraclough 2007).
The HIS equipped public hospital is taken as an exemplar case study since it complies with the definition of being a hospital that has gone through the full series of assimilation stages. The uniqueness of this hospital is that it was built with an integrated hospital information system and was only opened to the public after testing with medical staff and administrators was done over a period of 2 years. The hospital consists of 19 medical departments, 11 diagnostic and clinical support services, 6 non-clinical support services, and 6 management departments including IT, administrative, human resources, finance, accounting and public relations. The organisation chart for this hospital can be found in Appendix 1.

Since the hospital was built to have an organisation wide use of the IS/IT, all hospital staff were considered potential interview participants. The hospital staff interviewed were asked about their experiences with using the HIS, including any problems and issues throughout system deployment. Primary focus was given to hospital staff who have been in the hospital throughout the acquisition and deployment stage in order to gauge their views and experiences in each of the assimilation stages.

1.3 Objective

This research aims to explore the HIS assimilation issues and through analysis of results, develop an HIS assimilation model. This model will be recommended for use as a guide to successfully integrate information systems in hospitals towards the assimilation of HIS.

The main research question for this study is:

*How can a systematic focus on assimilation facilitate sustained use of healthcare information systems (HIS)?*

In answering the main research question, the following sub-questions will be answered. The sub-questions include:

a) *Why is assimilation of HIS important?*

b) *Why are HIS generally poor with regard to sustained use?*
1.4 Significance

This research involves the exploration of issues which surround technology innovation assimilation in a healthcare environment. It is necessary to address the assimilation issues and foresee the importance of technology, organisation and environment components which act as facilitators to a successful HIS assimilation. Thus, this research addresses gaps and challenges by merging different or commonly disparate theoretical frameworks as mentioned earlier in the introduction to explore the technology assimilation issues and identify facilitators to successfully assimilate HIS.

It is important to underscore the importance and significance of this study in light of exponentially increasing healthcare costs globally and the growing trend of healthcare organisations to implement HIS as a solution to stem such cost increases (Bodenheimer 2005; Hillestad et al. 2005). With the huge reliance today on HIS by healthcare organisations, this research will serve to facilitate better, more effective and efficient use of HIS and thereby support superior value driven healthcare delivery. This research will also address a significant void in the existing literature, and contribute to the body of academic and industry-based knowledge.

1.5 Thesis Outline

This chapter has provided an overview of the intended study and presented the research objective that guides this research.

Chapter 2 presents the literature review which further explores the research issues, aims and theories in a broader context. The history, evolution, current issues and limitations of the current IS/IT prospect in healthcare are discussed.

Chapter 3 presents the chosen research paradigm, research design and methods. The chosen qualitative method and interpretivist view is justified in this chapter with explanation on the selected embedded case study approach. This chapter also explains the ethics consideration that is required for data collection purposes.

Chapter 4 provides the analysis and findings from the interview highlighting expected findings, emerging themes and significant findings.
Chapter 5 provides discussion on the themes, consistency of findings with theories, implication and recommendations to practice and case study reflection.

Finally, Chapter 6 provides the conclusion for this research especially highlighting how the research questions were answered, limitations of this research and future study.
CHAPTER 2

2 Literature Review

The goal of this research is to explore HIS assimilation issues in hospital groups and to develop an HIS assimilation model. This model will serve as a guide to successfully assimilating HIS in healthcare settings. The following literature review serves to highlight that currently there exists a gap between the level of enthusiasm amongst healthcare professionals during the initial and later stages of information systems assimilation (Blumenthal & Glaser 2007; Damberg et al. 2009; Lapointe & Rivard 2006). The enthusiasm is typically high during the initial stage; however, once the system is being deployed and ready for adoption the end result is normally a disappointment or failure. After initial adoption, members of the organisation often lack skills and knowledge to leverage the full potential of the system which causes misalignment between the new systems being implemented and the user’s work environment. Due to the complexity of this issue the literature will be presented as follows:

1. Defining information systems/information technology (IS/IT) in healthcare (Section 2.1), followed by the evolution of IS/IT in healthcare (Section 2.1.1), and finally the current prospects for IS/IT in healthcare (section 2.1.2), describing the current usage of healthcare technology applications in various countries throughout the world.

2. Technology innovation adoption in healthcare (Section 2.2) which describes the role of technology innovation in the healthcare environment, followed by diffusion innovation theory (Section 2.2.1), theory of innovation assimilation and how it is applicable to this study (Section 2.2.2), Technology-Organisation-Environment framework and its relevance to this study (Section 2.2.3), and finally the use of IT resources from the Resource Based View of the Firm theory and how it relates to this study (Section 2.2.4).

3. The Malaysian context and healthcare system (Section 2.3 and 2.4) which describes the overall view of the history of Malaysian healthcare system, issues with the Malaysian healthcare system (Section 2.4.1), healthcare information
systems in Malaysia (Section 2.4.2), the use of Total Hospital Information Systems (THIS) in Malaysia (section 2.4.3) and issues with IS/IT in Malaysian hospitals (Section 2.4.4).

4. Implications from the literature for this study (section 2.5), the development of the conceptual framework for HIS assimilation (Section 2.5.1), the HIS assimilation stages (Section 2.5.2) and the Technology-Organisation-Environment (TOE) concepts (2.5.3).

5. Summary and significance of the study based on the literature (Section 2.6).

2.1 Information Technology/Information Systems (IS/IT) in Healthcare

The healthcare industry is seen as one of the most information intensive industries (Wager, Lee & Glaser 2005; Wickramasinghe 2000). Progressively IS/IT has been recognized as a tool to facilitate more efficient utilization of all the data and information within the healthcare industry. In order to understand the role of IS/IT in healthcare, it is first necessary to understand the different terminologies used in describing the use of technology. The terms IS and IT may be used interchangeably and differently but essentially are used to describe the same concepts. Nevertheless, the same terms may also be used to describe different concepts depending on the way the terms were defined in a particular context. Information technology is described as the combination of components in a computer and includes hardware and software with the data and telecommunication technology (Wager, Lee & Glaser 2005). Whereas an information system (IS) is defined as the interaction of data, processes, people and information technology to collect, process, store and provide an output to the information needs of the organisation (Whitten, Bently & Dittman 2004). Various management literature has used the terms IT and IS interchangeably (Wager, Lee & Glaser 2005). The term information communications technology (ICT) can also be used. Throughout the remainder of this thesis, the term IT will be used jointly with IS to become IS/IT since information technology is involved as a component in every part of information systems.

The research focuses on the use of IS/IT in healthcare industry, specifically on the use of HIS which incorporates the arrangement of data, process, people and information
technology in order to collect, process and provide output to the healthcare organisation. Hence both information technology and information systems (IS/IT) is applied in the use of HIS within this context.

It is also imperative for this study to look at how IS/IT has been incorporated into healthcare delivery historically. The next section outlines the evolution of IS/IT in healthcare throughout the last 40 years and is followed by an assessment of the current prospect of IS/IT in the healthcare industry.

2.1.1 Evolution of IS/IT in Healthcare

IS/IT functions have evolved over the years in not only being a technology provider but also a strategic partner and service provider (Salle & Rosenthal 2005; Wachob & McCord 2005). IS/IT has become a strategic necessity for developing an integrated IS/IT infrastructure in many industries in order to ensure the quality of service that is being provided (LeRouge, Mantzana & Wilson 2007).

Historically, IS/IT in the healthcare industry has evolved globally in various developed countries since mid-1960s (Protti, Johansen & Perez-Torres 2009; Shortliffe 1999, 2005). In the United States, this was a time when hospitals benefited from funds made available through federal and state government funding, which allowed them to spend on new facilities and expand their services (Wager, Lee & Glaser 2005). However, healthcare executives felt that there was a need for IS/IT that could automate the hospital’s financial processes, such as billing and cost reporting. The early administrative and financial applications during 1960s ran mostly on large mainframe computers with centralized processing for the management of data. There were very few vendor developed products as most systems were developed and maintained in-house for larger hospitals (Shortliffe 2005; Wager, Lee & Glaser 2005).

During the 1970s, most mainframes were still in use however there was an advancement towards minicomputers which were smaller and more affordable (Friede, Blum & McDonald 1995). In addition, there was an increasing demand and interest in specific healthcare applications such as laboratory, radiology and pharmacy (Wager, Lee & Glaser 2005). At this stage the vendor community began developing turnkey systems for
hospitals which were interested in having fully functioning clinical applications that work by just turning on the system (Wager, Lee & Glaser 2005). However, these applications were made to the vendor’s specifications with very little room for modification or customization based on the organisation’s needs (Ball et al. 1991; Wager, Lee & Glaser 2005).

The mid-1980s brought about immense changes to the world of computing in the healthcare industry. This was the time where microcomputers (better known then as personal computers) were smaller, more powerful and far more affordable than mainframe computers (Friede, Blum & McDonald 1995). It was in this era that the personal computers influenced distributed data processing as well as the expansion of clinical information systems. This advancement also allowed HIS vendors to develop a range of administrative and clinical applications for various healthcare settings. This resulted in the purchasing of individual applications for specific clinical usage (Wager, Lee & Glaser 2005). Based on these practices of purchasing the best from multiple vendors for individual departments, challenges began to develop when hospitals tried to integrate data to allow interoperability and communication among these different systems (Wager, Lee & Glaser 2005).

The advent of the Internet during the 1990s brought about a revolution as to how organisations communicate and conduct business. The growth of the Internet has had a major impact on healthcare organisations enabling the introduction of electronic medical records, telemedicine and telehealth (Shortliffe 1999). Telemedicine enables healthcare providers to deliver healthcare services to patients in disparate locations (Bashshur 1995). Telemedicine programs during the 1990s started out as pilot or demonstration projects that did not commission immediately throughout healthcare facilities due to issues of professional consultants claiming reimbursement for services provided via telecommunication systems to patients in qualifying sites approved by the government (Wager, Lee & Glaser 2005). The 1990s also brought about an increasing number of participants in the vendor community that developed various clinical applications which made healthcare products more widely available and affordable. Some of the clinical applications developed include the computer-based patient record (CPR), which was
commonly used in hospital and physician practices according to the United Stated Institute of Medicine (IOM) (Wager, Lee & Glaser 2005). Nevertheless, some of the developed CPR products did not reach their targeted goal of storing and retrieving patient data as only 10 percent of hospitals and 15 percent of physician practices chose to implement (Steen & Detmer 1996; Wager, Lee & Glaser 2005).

From the year 2000 until 2011 there has been an intensive effort by various developed countries such as United States, Denmark and Sweden in improving the electronic health record (EHR) as a result of various medical errors and issues with regard to patient safety (Katsma et al. 2007). The need for synchronization of data with a proper standard is believed to be crucial, therefore the Health Level Seven (HL7) standard was developed for EHR implementation (Wager, Lee & Glaser 2005). With the advancement of the Internet, there was a widespread use of emerging technologies such as wireless applications (Varshney 2007; Wickramasinghe & Misra 2004). There were studies undertaken which indicated that the emergence of wireless technologies used by physicians (such as personal digital assistance (PDAs)) facilitated functions such as patient appointments, drug information and medical references (Dee, Teolis & Todd 2005; Tachakra et al. 2003). These studies support the claim that current and emerging use of technology in healthcare is indeed aimed at providing a well-integrated HIS in the effort to improve patient safety, increase quality of medical care and decrease healthcare costs to the community (Lee, K & Wan 2003).

Various positive and negative attitudes have been identified amongst hospital personnel in accepting IS/IT as part of their job. There exist difficulties in adopting and implementing IS/IT in the healthcare industry (Barnes 2001; Bhattacherjee & Hikmet 2007; Castro 2007; Glaser 2002). Some of these difficulties are due to:

1. Large numbers of small healthcare organisations such as general practitioner’s (GP) clinics and district/rural hospitals which make it difficult to implement costly healthcare hardware and software.

2. Lack of IT trained professionals to handle technical issues of the IS/IT
3. Vendors not wanting to invest in small healthcare organisations due to issues concerning recovery of costs.

4. Difficulty in data integration across multiple healthcare providers.

5. The complexity of the medical processes that leads to the difficulty of designing a good clinical information system.

6. The complexity of medical data in which there can be many idiosyncratic ways of coding it to provide meaningful clinical interpretation.

7. The nature of the organisation itself which often has two powerful organisation structures between the medical and administrative staff (Wager, Lee & Glaser 2005).

Table 1 below describes the major healthcare technology applications and tools that have currently been implemented in an effort to improve healthcare delivery:

<table>
<thead>
<tr>
<th>Initiatives</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Computerised Physician Order Entry (CPOE) system</strong></td>
<td>A reduction in drug interactions, as well as unnecessary repetition of tests and repetitive tasks that may already have been performed but not recorded or available in the paper-record system (Davenport 2007; Walker et al. 2005)</td>
</tr>
<tr>
<td><strong>ePrescribing</strong></td>
<td>Stringent monitoring of generic medications so as to minimise costs, provides prescriptions electronically to pharmacies if preferred by the patient, checks for drug interactions and poly-pharmacy issues, alerts providers as to when a repeat prescription is due, alerts to allergies, provides a drug reference guide, provides patients with details of their medications and side effects if required as an additional resource (BSR 2008).</td>
</tr>
<tr>
<td><strong>Personal digital assistants (PDA)</strong></td>
<td>The usage of PDAs to receive results and get information quickly and reliably, look at EMRs, request blood products or supplies as well as collaborating with colleagues who may need support (BSR 2008).</td>
</tr>
<tr>
<td><strong>Picture Archiving and Communication System (PACS)</strong></td>
<td>A system for digital imaging, teams can now collaborate on patients who are not located geographically together, seeking specialist advice and input when necessary and supporting both patients and care providers in the rural and remote areas of the world (BSR 2008).</td>
</tr>
<tr>
<td><strong>MARVIN</strong></td>
<td>An application to tackle substance abuse in remote communities, and features animated three-dimensional characters that resemble community leaders speaking their own language (BSR 2008).</td>
</tr>
</tbody>
</table>
| **Patient Self-Service Kiosks**                 | Hospitals in the US are starting to implement kiosks for patients to register at the hospital to access services, provide information to enquiries and directions, as well as registering for appointments and authorising future email communication, similar to the self-service kiosks at airports (Castro 2007). Patients are able to complete registration forms independently of staff and so this has reduced the time that people have to wait to see a member of staff and has also decreased the number of staff that need to
<table>
<thead>
<tr>
<th>Initiatives</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speech Magic</td>
<td>A voice recognition product which enables healthcare IT system providers to deliver integrated digital dictation and speech recognition capabilities for capturing information on patient (Trinkaus &amp; Gaisser 2010)</td>
</tr>
<tr>
<td>MedQuery</td>
<td>A software that has been developed to analyse pharmacy and laboratory results to identify potential omissions and errors in patient care (BSR 2008)</td>
</tr>
<tr>
<td>Web Portals</td>
<td>A one stop centre providing opportunities for clinicians and consumers with a consistent, integrated point of access to information, applications and people (BSR 2008)</td>
</tr>
<tr>
<td>Telemedicine</td>
<td>“An integrated system of healthcare delivery that employs telecommunications and computer technology as a substitute for face-to-face contact between provider and client” (Bashshur 1995).</td>
</tr>
</tbody>
</table>

Efforts are still taking place in ensuring that IS/IT is being utilized and successfully implemented in a number of healthcare innovations throughout the world. One example of this innovation is an integrated hospital information system (Kim, Lee & Kim 2002). An integrated hospital information system is defined “as an exclusive computer system developed to enhance the clinical and administrative function of a hospital” (Kim, Lee & Kim 2002). The Electronic Medical Record (EMR) is a common vital application in the hospital information system (Abbott & Coenen 2008; Blumenthal & Glaser 2007; Chen 2001; Jensen & Aanestad 2007; Naing, Zainuddin & Zailani 2008; Radhakrishnan, David & Zaveri 2008). Naing, Zainuddin & Zailani (2008) believe that by implementing the EMR hospitals can save costs associated with the daily administration of the hospital, such as record keeping, improve workflows, practice management and billing. One of the main reasons for bringing IS/IT into hospitals was to eliminate the manual paperwork and have a central storage for all patient’s details and medical records (Wager, Lee & Glaser 2005). This would ensure that doctors and nurses would be able to handle records and data in a more organized manner which will lead to easy access of information relating to the patient. Many other developments have been made to a hospital information system in order to incorporate better use of technology – for example, decision support systems, a search facility for medical solutions and communication between experts in the medical field throughout the organisation and globally (Fadlalla & Wickramasinghe 2004).
2.1.2 The Current State of IS/IT in Healthcare

Continuous efforts have been carried out in order to improve the current technological scenario in the healthcare industry (Øvretveit et al. 2007). Many countries produce strategic information system plans for their large scale health systems for the benefit of their citizens (Barnes 2001; Department of Human Services 2008). Initiatives such as E-Health, Electronic Health Record (EHR), Hospital Information System and Telemedicine will generally bring about the usage of information systems as a means to provide better health services to the population and overcome challenges that has been perceived as cumbersome by people seeking medical treatment (Jha et al. 2008). The main aim is to eliminate manual processes that are now seen as a major hindrance towards providing fast efficient services.

Whilst having IS/IT implemented, there exists other challenges in the way that information is stored, shared and distributed. The main problem in this context lies with the way information is being handled; it still revolves around pen, paper and human memory. The manual method may not be suitable in meeting the demands of the current technological environment (Costa, de Oliveira & de Oliveira Machado 2004). With large numbers of private and public hospitals, general practices, clinical specialists, and allied health facilities information is not integrated and mostly stored on paper (Omachonu & Einspruch 2007). This causes significant challenges in the sharing of patient information due to duplication of information across the multiple healthcare service providers and geographic distances. The non-existence of integrated information storage may even cause significant challenges in providing reports for the nation’s health surveillance and policy, health services planning and clinical operational decision making (Department of Human Services 2008). The use of IS/IT in the healthcare sector is far behind other knowledge rich industries such as the financial and telecommunication industries (Department of Human Services 2008; Leape & Berwick 2005). Furthermore, the healthcare sector has also been reported to be slow in adopting HIS and sustaining IS/IT use (LeRouge, Mantzana & Wilson 2007; Spil & Stegwee 2001; Suomi, R 2001).

Table 2 illustrates the initiatives taken by some of the countries throughout the world in developing and implementing efficient IS/IT for healthcare. In spite of the advancement
of technology being implemented in the healthcare sector either in developed or developing countries throughout the world, there are still issues with implementation. The key issues include, to what extent the systems implemented will support the strategic goals of the organisation and work processes of the medical personnel. Overcoming these barriers is essential for the widespread of healthcare technology adoption (Wager, Lee & Glaser 2005).

Table 2  Healthcare Technology Initiatives around the World

<table>
<thead>
<tr>
<th>Continent</th>
<th>Countries</th>
<th>Technology Initiatives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Europe</td>
<td>United Kingdom</td>
<td>Electronic patient booking systems, prescription messaging, Picture Archiving and Communications system (PACS), key patient information summary such as medication and allergies, e-Referral systems, clinical repositories, test results storage and send capability (Detmer 2000)</td>
</tr>
<tr>
<td></td>
<td>Denmark</td>
<td>Hospital electronic health record, GP computing, development of integrated communication capacity with home based care and making treatment information available through a portal, national registries and databases, standards development for data interchange purposes (Protti, Johansen &amp; Perez-Torres 2009)</td>
</tr>
<tr>
<td></td>
<td>Sweden</td>
<td>Electronic Health Record, Integration of health records across all hospitals (Anderson et al. 2006)</td>
</tr>
<tr>
<td></td>
<td>Germany</td>
<td>Smart-card technology to use advanced security features to protect the stored personal medical data (Anderson et al. 2006)</td>
</tr>
<tr>
<td>North America</td>
<td>United States</td>
<td>Electronic Health Records, Personal Health Records, telehealth, health information network (Davenport 2007)</td>
</tr>
<tr>
<td></td>
<td>Canada</td>
<td>Diagnostic imaging, medication management, registries, laboratory and public health surveillance, telehealth (Jha et al. 2008; Mercer 2001)</td>
</tr>
<tr>
<td>Asia</td>
<td>Singapore</td>
<td>A good level of IS/IT penetration in clinical, administrative and logistics activity in seven main hospitals. OphthWeb a telemedicine tool delivering optometric treatment services. Teleophthalmology. (Chew et al. 1998; Pan &amp; Pokharel 2007)</td>
</tr>
<tr>
<td></td>
<td>Malaysia</td>
<td>Hospital information systems which covers all aspects of the hospital’s operation such as clinical, administrative and financial systems (MOH-Malaysia 2010)</td>
</tr>
<tr>
<td></td>
<td>Taiwan</td>
<td>Telemedicine, National Health Insurance Smart Card to update patient’s record (Liu et al. 2006)</td>
</tr>
<tr>
<td></td>
<td>Japan</td>
<td>Hospital Information System, telemedicine, telehealth, decision support system, integration of digital patient records between some local, regional and single hospitals (Ishikawa et al. 2007; Oteno et al. 2008)</td>
</tr>
<tr>
<td>Australia</td>
<td>Australia</td>
<td>Electronic Health Records, E-Health initiatives (Mitchell 2000)</td>
</tr>
<tr>
<td></td>
<td>New Zealand</td>
<td>E-Health, data and messaging quality, secure online transfer of health information and national registers (Jha et al. 2008)</td>
</tr>
</tbody>
</table>

2.2 Technology Innovation Adoption in Healthcare

The introduction of healthcare IS/IT technologies into the healthcare environment has led to increased efficiency in providing better services and improved processes for healthcare practitioners (Kern & Jaron 2003). Adoption of IS/IT in the healthcare industry is seen as a way of innovating with technology in order to bring about positive outcomes especially
in assisting the work processes of the clinicians in the adopting organisation. Positive outcomes are not always the case in the healthcare environment (Allen 2000; Snyder-Halpern 2001).

Table 3 below describes some research findings pertaining to IS/IT technology innovation that has been implemented in the healthcare industry and highlighting key issues, success stories and recommendations.

Table 3  Technology Innovation in Healthcare

<table>
<thead>
<tr>
<th>Author</th>
<th>Technology innovation</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Henry &amp; Stone (1999)</td>
<td>Medical Information system</td>
<td>Fear of using the technology is still a concern due to lack of knowledge about using computerizing healthcare facilities, anxiety of using technology as it could bring about less patient care as most of the time will be spent on learning how to use the computers.</td>
</tr>
<tr>
<td>Smits &amp; van der Pijl (1999)</td>
<td>Hospital Management and Information System</td>
<td>“...The use of IS/IT in the Netherland hospital was not developed according to the needs and developments in the hospital organisation over the past decade”</td>
</tr>
<tr>
<td>Pare &amp; Elam (1999)</td>
<td>Clinical Information System</td>
<td>Lack of formal training in computing and medical informatics for physicians and concerns with the usage of computers due to increasing role of government in healthcare which could lead to the potential loss of professional privacy. The benefits of computers are acknowledged, however, as a means of obtaining up-to-date information and providing better healthcare services. In summary, physicians do not really resist to technology change but the way the technology is implemented by the management.</td>
</tr>
<tr>
<td>Hebert (2000)</td>
<td>Patient Care Information Systems (PCIS)</td>
<td>Major focus was given to training; however the organisation did not develop the capacity to teach people how to use the system. Technology cannot be moved with similar capacity and expectations from one hospital to the other, one hospital may recognize its benefits immediately and suit to their organisation structure and work processes whereas another hospital could fail to realize its benefits almost immediately or in the long run.</td>
</tr>
<tr>
<td>Chen (2001)</td>
<td>Electronic Medical Record (EMR)</td>
<td>Challenges may include security and privacy issues, access control, reliability of the documentation, multimedia document retrieval, legal and ethical issues, implementation issues. Solutions include applying technological security and behavioural approaches such as authentication, encryption and public key infrastructure, internal security management applying limited access to users, government intervention in realizing the patient privacy protections act. Success of implementation includes support from leading physician, availability of local technical support and ongoing training.</td>
</tr>
<tr>
<td>Wickramasinghe &amp; Mills (2001)</td>
<td>Electronic Medical Record (EMR)</td>
<td>The EMR is able to function as a knowledge management system which enables and facilitates the generation of new knowledge pertaining to treatment protocols and simultaneously allow the healthcare knowledge workers to share and exchange knowledge. The adoption and diffusion of e-medical record systems requires further research investigations and elaboration.</td>
</tr>
<tr>
<td>Author</td>
<td>Technology innovation</td>
<td>Findings</td>
</tr>
<tr>
<td>--------</td>
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</tr>
<tr>
<td>Costa, de Oliveira &amp; de Oliveira Machado (2004)</td>
<td>Drug prescription and distribution system</td>
<td>Contributions of system include: decrease in medication exchanges due to usage of barcode and indicators of mismatch between medication picked and medication prescribed, storage and statistics of number of failures in filling orders which leads to better quality of service and reduce delays. End user was also satisfied with the ongoing training policies.</td>
</tr>
<tr>
<td>Ash, Berg &amp; (Cohera 2004)</td>
<td>Patient Care Information Systems (PCIS)</td>
<td>Silent errors exist with the implementation of PCIS and can be categorized into 2 categories: errors with the process of entering and retrieving information and errors with the communication and coordination process that the PCIS is supposed to support. In order to avoid the unintended consequences of these errors, some recommendations include education namely in medical informatics and technology, systems design, implementation and conducting further research especially using qualitative techniques to identify why and how the problems exists.</td>
</tr>
<tr>
<td>Li et al. (2005)</td>
<td>Mobile Nursing Technology</td>
<td>Adoption of mobile nursing technology is highly associated with business competition, capability of external suppliers and organisation’s internal needs.</td>
</tr>
<tr>
<td>Zheng et al. (2005)</td>
<td>Clinical Decision Support system (CDSS)</td>
<td>There exist resistance in using the system and a decreasing level of usage rate among the users over time. It is recommended that if the CDSS is to be used it should incorporate workflows which are consistent with the physicians’ work processes.</td>
</tr>
<tr>
<td>Lu et al. (2005)</td>
<td>Personal Digital Assistant (PDA)</td>
<td>There are numerous benefits that PDAs can offer clinicians in delivering better services. However, there are some necessary measures that needs to be taken in order to increase its usage such as: better designed PDAs that suits medical environment, more institutional support, seamless integration of PDA to hospital information system and satisfactory security measures.</td>
</tr>
<tr>
<td>Suomi (2005)</td>
<td>Electronic Patient Records (EPR)</td>
<td>Contributing factors for the success of EPR are: the EPR’s huge relative advantage, external factors and the rich availability of information on EPR through different communication channels. The major hindrance towards the success of EPR adoption would be: the lack of observable benefits and resources to implement the system.</td>
</tr>
<tr>
<td>Khoumbati, Themistocleous &amp; Irani (2006)</td>
<td>Enterprise Application Integration (EAI)</td>
<td>EAI is said to provide an environment that could integrate disparate information systems which allows greater advantage in terms of saving money, time and reducing risks during implementation. Nevertheless, in adopting EAI, these are some of the issues that requires immediate consideration: security and confidentiality, educating staff and patients on EAI implementation and hiring of practitioners with EAI knowledge or training IT staff on EAI.</td>
</tr>
<tr>
<td>Chang et al. (2006)</td>
<td>Picture Archiving and Communication Systems (PACS)</td>
<td>The use of PACS is seen as a tool in gaining competitive advantage. Costs of implementing PACS were not an issue as the adopters could foresee the benefits of using PACS.</td>
</tr>
<tr>
<td>Lee &amp; Shim (2007)</td>
<td>Radio Frequency Identification (RFID)</td>
<td>The key factors in determining the successful adoption of RFID are: the presence of a champion, technology push and need pull. Organisations also need not consider in adopting new technology unless reasons such as performance gap and market uncertainty was seen as crucial to the organisation.</td>
</tr>
<tr>
<td>Jensen &amp; Aanestad (2007)</td>
<td>Electronic Patient Record (EPR)</td>
<td>…surgeons welcomed the EPR system as long as it provides direct clinical benefits to their work and eased their work...</td>
</tr>
</tbody>
</table>
Table 3, provides a summary of healthcare IS/IT innovation adoption complexity which is similar to that of other industries. The healthcare IS/IT innovations are influenced by a wide variety of factors such as external environment, characteristics of the healthcare organisation, the technology readiness, knowledge readiness and process of implementing the technology (Snyder-Halpern 2001). Innovating with IS/IT does not always lead to success after immediate adoption (Swanson 2004). Various publications in the literature highlight problems with healthcare IS/IT implementation and identify facilitators to assist firms in successful in IS/IT implementation (Bradford & Florin 2003; Chatzoglou & Diamantidis 2009; Fehse, KrABBendam & Boer 2002; Fichman & Kemerer 1999; Øvretveit et al. 2007; Skok, Kophamel & Richardson 2001; Swanson 2004; Varonen et al. 2008; Walley & Davies 2002; Wickramasinghe 2000; Wickramasinghe & Goldberg 2008; Yetton, Sharma & Southon 1997). Although IS/IT implementation success remains an essential focus area of IS/IT research, there is an increasing interest in addressing the issue of organisation assimilation of IS/IT innovation due to the importance of IS/IT
efficiency in the adopting healthcare organisation (Fichman 2000; Gallivan 2001; Keim, Malinowski & Weitzal 2005; Swanson 2004; Zhu, Kraemer & Xu 2006). This research emphasises the focus on assimilation of HIS as an innovation to healthcare organisations through the influence of various established theories in information systems. The following sections will discuss the major theories that are significant to this study. This discussion will introduce the context of this research and the development of the conceptual framework to be used for the HIS assimilation model derivation.

### 2.2.1 Diffusion of Innovation Theory

The diffusion of an innovation can be described as the process by which knowledge of an innovation spreads across a population, and through the decisions made by a unit in the organisation whether or not the innovation is adopted or rejected (Carter et al. 2001; Rogers 2003a). Rogers’ (1983) work is considered groundbreaking with regard to technology innovation and diffusion, therefore most studies that focus on the diffusion of innovation with respect to technology begins with Rogers. Given this, the present study also draws heavily upon the work of Rogers (Rogers 2003a, 1983). Findings for Rogers’ research indicate that adopters of most new innovations or ideas can be categorized as innovators, early adopters, early majority of adopters, late majority of adopters and laggards, based on the mathematically-based Bell curve. Adoption over time will indicate an “s-shaped curve” (an S curve) to show that the technology adopters may be slow at start, more rapid as adoption increases, then ultimately arrive at a more stagnant rate. This is more widely known as the diffusion of innovation model (Rogers 2003b). While Rogers’ model was considered the first process model of innovation adoption and implementation, over the years there have been many other models proposed pertaining to the areas of management (Meyer & Goes 1988) and information technology (Cooper & Zmud 1990; Kwon & Zmud 1987; Saga & Zmud 1994).

Table 4 provides a summary of the key findings from the diffusion of innovation literature.

<table>
<thead>
<tr>
<th>Category</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organisation</td>
<td>Organisations must understand and manage their implementation process especially management’s recognition of critical issues to be raised and resolved</td>
</tr>
<tr>
<td>Category</td>
<td>Findings</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Literature Review</td>
<td>throughout the implementation process (Cooper &amp; Zmud 1990). There is a need for strategy development and resource allocation by managers between design stage and implementation stage (Yetton, Sharma &amp; Southon 1997). Managerial influence are most likely higher at design stage rather than during the implementation (Yetton, Sharma &amp; Southon 1999). Managers have to understand the critical nature of timing if they are to shift and implement new technology using good IT innovation theories (Lyytinen &amp; Rose 2003).</td>
</tr>
<tr>
<td>Technology innovation process or assimilation</td>
<td>Develop strategies for assimilating technologies into its operations through support, advocacy and total commitment (Agarwal, Tanniru &amp; Wilemon 1997). CIO’s business and IT knowledge, relationship with top management and informal interaction with senior management team is found to be significant in influencing IT assimilation (Armstrong &amp; Sambamurthy 1999). Introduction of the assimilation gap which provides a new way to assess the prospect of the innovation at the early stages of the entire diffusion cycle (Fichman &amp; Kemrer 1999). There should be more research on technological innovation process (Allen 2000). Diffusion of innovation should be studied as a process consisting of multiple stages and measures (Carter et al. 2001). Serious gap uncovered in finding out what processes are innovations in healthcare implemented and sustained in a particular context, and how this process can be enhanced (Greenhalgh et al. 2004). The concept of organisational assimilation of IT innovation is under explored in the literature (Swanson 2004).</td>
</tr>
<tr>
<td>Traditional Diffusion of Innovation (DOI) research</td>
<td>Adding ‘result demonstrability’, ‘visibility’, image and voluntariness to the initial 5 characteristics of innovation (Moore &amp; Benbasat 1991). Due to lack of general theory on innovation, the development of more middle range theory for specific technology and adoption context is recommended (Fichman 2000). The use of traditional diffusion models should be expanded to more complex, mandatory and deep usage (Chin &amp; Marcolin 2001). New constructs such as absorptive capacity are needed to complement traditional DOI models (Gallivan 2001). Uses traditional DOI theory to frame and understand issues with ERP implementation (Bradford &amp; Florin 2003; Rajagopal 2002). The traditional DOI model is able to accurately describe nurses’ behaviour in adopting workplace innovation (Lee 2004).</td>
</tr>
</tbody>
</table>

Based on the cited literature in Table 4, there is a clear need for more research to be done on the IT innovation assimilation area grounded through the diffusion of innovation theory(s) in investigating the failure or rejection of innovation usage amongst a population in a particular context. The review of relevant theoretical research carried out in the area of IS/IT innovation assimilation based on the diffusion of innovation literature and specifically focused on the healthcare industry is discussed in the next section.
2.2.2 Theory of Innovation Assimilation

Innovation can be defined as an idea, practice, technology or entity that is considered to be new by an individual, a group or any other units of adoption (Rogers 2003b). With innovation comes the processes initial discussion and idea for innovation generation, introduction of the idea for innovation, evaluation of the idea for innovation through the identification of needs and priorities of this new innovation. The process of innovation assimilation involves decisions made by members of the organisation relating to the possibility of the innovation being potentially useful in solving the organisational issues, followed by the adoption of the innovation and finally the institutionalization of the innovation (Greenhalgh, Robert & Bate 2008; Li et al. 2005; Zhu, Kraemer & Xu 2006).

The need for innovation assimilation can be seen in many of the HIS implementation literature (Heeks 2002; Jayasuriya & Anandaciva 1995; Littlejohns, Wyatt & Garvican 2003). In a study of the implementation of HIS in developing countries such as South Africa and Philippines, the results of HIS evaluation reveals that three quarters of HIS applications were found to have failed with no evidence that the system have actually improved healthcare professional’s productivity (Littlejohns, Wyatt & Garvican 2003; Willcocks & Lester 1996). Some of the problems highlighted at the South African hospitals were related to infrastructure and implementation processes, such as delay in the network upgrades, delay in the development of the proposed modules, features that were too advanced for the healthcare personnel which required them to have intensive training, failure of maintenance support to provide quick and reliable services and frustration of personnel having to use selective passwords in accessing certain modules (Littlejohns, Wyatt & Garvican 2003). As a response to the resentment of the HIS usage, a new contract was given to a different company with the hope of improving the current problematic situation. This action failed to address the issues and as a result, a new system was developed. The new system required all healthcare personnel to undertake training to be familiar with the new application (Littlejohns, Wyatt & Garvican 2003).

In the study of a healthcare facility in the Republic of the Philippines, the author concurs with Heeks (2002) who found that many of the developing countries are facing HIS sustainability issues caused by the failure to assimilate the design and actual
implementation of systems in many hospitals (Heeks 2002). In the case of the hospital under study in the Philippines, the system acquired was based on a successful model in an American hospital, without considering the currently available IT resources in the Philippines’ hospital. Cultural differences were not considered during the implementation of the HIS (Jayasuriya & Anandaciva 1995). The implementation process lacked a skilled project manager, lacked adequate technological infrastructure and proficient information management practices (Jayasuriya & Anandaciva 1995). Heek’s (2002) study showed that the hospital suffered from an assimilation gap during its implementation and operation (Heeks 2002; Jayasuriya & Anandaciva 1995). As a result of the assimilation gap, these systems did not meet the healthcare personnel’s requirements and had to be abandoned within less than a year (Heeks 2002). Mismanagement of the implementation process of the HIS, and the assimilation gap lead to of the information system failing to realise its benefits at considerable monetary cost (Littlejohns, Wyatt & Garvican 2003). Therefore, a study on the processes of innovation assimilation is clearly important.

2.2.3 Technology-Organisation-Environment (TOE) Framework

In the discussion of assimilation gaps, facilitators that influence the innovation assimilation stages should be considered. Tornatzky & Fleischer (1990) introduced the technology-organisation-environment (TOE) framework in 1990. Their framework provides details that firms should consider when studying components that influence assimilation of technological innovation. These components are grouped in three aspects: technological context, organisational context and environmental context (Tornatzky & Fleischer 1990; Zhu, Kraemer & Xu 2006). The components are represented in Figure 1.

The Technology context comprises of the internal and external technologies pertaining to the firm involved and includes both equipment and processes (Tornatzky & Fleischer 1990). The organisational context: involves the characteristics and resources of the firms such as firm size, managerial structure, human resources, amount of slack resources and linkages among employees (Tornatzky & Fleischer 1990).
The environmental context includes the structure of the industry, the firm’s competitors, the macroeconomic concept and the regulatory environment (Tornatzky & Fleischer 1990).

These elements have been identified as being both the constraints and opportunities for technological innovation, thus these are also considered as components that influence the way a firm sees the need to, and ways to adopt new technology (Tornatzky & Fleischer 1990).

![The Original TOE Model](image)

**Figure 1** The Original TOE Model (Tornatzky & Fleischer 1990)

This framework is also applied in the work of Zhu et al. (2006) studying factors that influence e-business assimilation stages in both developed and developing countries. However, the original diagram by Tornatzky & Fleischer (1990) has been modified to suit their study in an e-business context. The adapted model by Zhu et al. (2006) is depicted in Figure 2. Results from the study of Zhu et al. (2006) indicate that factors such as technological readiness, under the technological context, and regulatory environment, under the environmental context, are the most relevant factors in the innovation assimilation process - especially for developing countries. The organisational context
which involves elements such as firm size and managerial obstacles has been verified through the IS literature which provides evidence of significant relationships of firm size and firm scope to IS/IT adoption and usage (Gurbaxani & Whang 1991; Zhu 2004).

Firm size is seen as an important organisational attribute for innovation diffusion (Rogers 2003a). With regard to assimilation stages, Damanpour (1996) argued that the relationship between firm size and assimilation stages may differ due to differences in activities carried out in each of the assimilation stages. Zhu et al. (2006) noted that larger firms usually initiate and adopt innovations due to their resource advantages in terms of financial, managerial and technical resources.
The managerial obstacles factor is referred to as the organisation’s lack of managerial skills and efficiency in handling change management, thus causing ineffectiveness in managing technology adoption and adaptation (Roberts et al. 2003). This is in line with Mata’s et al. (1995) view that the ability to merge managerial and IS/IT skills is highly dependent on the firms’ ability to assimilate information technology. This then requires firms to possess relevant managerial skills and overcome barriers in adopting and assimilating new technology. Therefore, in line with the HIS assimilation study, this research will adapt some of the factors in the TOE framework, such as hospital size and managerial obstacles as facilitators to the success of HIS assimilation in a healthcare context.

2.2.4 IS/IT Resources in Resource Based View

The IS/IT resources classification in the resource based view literature begins with Grant’s (1995) classification of key IS/IT-based resources, and was categorized into:

1. IS/IT Infrastructure: The tangible resource which includes IS/IT infrastructure components such as hardware and software.

2. IS/IT expertise: The human IS/IT resources which is divided into technical and managerial skills

3. IS/IT enabled intangibles: The intangible IS/IT enabled resources such as knowledge assets and customer service skills.

Ross et al. (1996) further extended the study by classifying that the relationship and use of resources such as IS/IT human resources, reusable technology infrastructure and strong IS/IT-business partner relationship together would result in faster strategic business needs in terms of cost effectiveness as compared to the organisation’s competitors. Description of these resources as defined by Ross et al. (1996) are listed in Table 5:

<table>
<thead>
<tr>
<th>Resource</th>
<th>Elements</th>
</tr>
</thead>
</table>
| IS/IT human resources | Strong competent technical skills  
                           | Excellent understanding of the business  
                           | Empowered IS/IT teams to work closely with clients in addressing business needs |
| Technology        | Sharable technical platform & databases  
                           | Well defined technology architecture |

Table 5    IS/IT Resource Elements (Ross, Beath & Goodhue 1996)
It is crucial for an IS/IT department to have strong IS/IT competencies and skills in order to be able to solve business problems and handle business opportunities through the use of information technology (Ross, Beath & Goodhue 1996). This can be further enhanced by being able to understand organisational processes and work closely with clients in gathering the necessary problem solving skills (Ross, Beath & Goodhue 1996). With the IS/IT infrastructure, the importance of a sharable platform and technology is essential for integrating systems in the organisation in order to make IS/IT applications more cost effective especially in the area of operations and support (Ross, Beath & Goodhue 1996).

Merging the studies of both Grant (1995) and Ross et al. (1996), Bharadwaj (2000) extended these concepts of IS/IT resources through an empirical study of the relationship between the IS/IT resources to organisation’s superior performance. Bhadrawaj (2000) defines all three resources according to Grant’s (1995) classification and refers to them as IT capabilities. The results indicate that firms should do much more than merely invest in IS/IT. Instead, firms should consider identifying ways in which to create a firm-wide IS/IT capability. The study by Bhadrawaj (2000) also suggests that the identification of the most important IS/IT resources and skills is actually the search in understanding the nature of superior IS/IT performance (Bharadwaj 2000).

Huang et al. (2006) further explored the study by Bhadrawaj (2000), through the similar usage of IS/IT resource based-view and concentrated on the same three resources. Their study however is more focused on the use of the IS/IT resources in relation to IS/IT investment. An interesting outcome from Huang et al.’s (2006) study is the revelation that the IS/IT infrastructure and human IS/IT resources cannot directly influence firm’s performance. However, the two resources provide an influence to intangible resources such as knowledge assets, improved customer service through IS/IT (as this makes the firm more responsive to customer’s needs), management of organisational knowledge, better synergy between the vendor and customers, improved coordination and sharing of resources across organisational divisions (Bharadwaj 2000; Huang et al. 2006). Hence,
these intangibles are grouped as IS/IT enabled intangibles (Bharadwaj 2000) which will directly influence the firm’s performance. Figure 3 denotes the original conceptual diagram used in Huang et al.’s (2006) research.

![Figure 3](image-url)

**Figure 3** Research Framework in the Study of Huang et al. (2006)

A study by Glaser (2002) on the strategic applications of IS/IT in healthcare organisation has brought about the identification of healthcare organisational IS/IT resources that were aimed towards “furthering organisational strategies and advancing the organisation’s abilities to achieve its goals”. The resources identified relevant to this study are listed below in Table 6.

**Table 6** Glaser’s (2002) Definition of the Organisation IS/IT Resources

<table>
<thead>
<tr>
<th>Resource</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical Architecture</td>
<td>Basic infrastructure comprising of networks, programming languages, operating systems, workstations and other basic technologies that form the foundation for the applications.</td>
</tr>
<tr>
<td>IS/IT Staff</td>
<td>Analyst, programmers, computer operators who manages IS/IT in the organisation</td>
</tr>
<tr>
<td>IT Governance</td>
<td>Organisation mechanisms which include committees, policies, procedures, best practices by which IS/IT strategies are formed, priorities are set, standards are developed and projects are managed.</td>
</tr>
</tbody>
</table>

Based on the list defined by Glaser’s (2002), this research includes IT governance as part of the technology component in the conceptual framework. The technical architecture and IS/IT staff in Glaser’s (2002) study is found to be similar to the definition of IS/IT infrastructure and human IS/IT resources from the previously mentioned literature on the use of IT resources in resource based view.
To further strengthen the usage of the identified IT resources in this research, a conceptual study done by Khatri (2006) which identified important resources for a healthcare organisation through the literature on resource based view is of relevance. It is interesting to note that the identified resources are similar to the resources identified by Grant (1995) and the resources tested by Bharadwaj (2000) and Huang et al. (2006). Khatri (2006) determined that it is worth examining the relationship between these resources and clinical outcomes through mediating variables such as organisational processes. Therefore, this research will look into the influence of IS/IT infrastructure and human IS/IT resources and IS/IT intangibles to successfully assimilate HIS into a healthcare facility.

2.3 The Malaysian Context

Previous research has highlighted various countries around the world that are undergoing healthcare reform to promote better services and healthcare well-being (Jha et al. 2008; Menadue 2003; Moisil & Jitaru 2006; Potti, Johansen & Perez-Torres 2009; Yasunaga et al. 2008; Zhang et al. 2007) One of the common initiatives is the plethora of e-health projects which involve the use of IS/IT in the healthcare facilities (Chang et al. 2007; Mitchell 2000; Moisil & Jitaru 2006). Malaysia is an example of a developing country that is progressing in its e-health initiative by having the healthcare IS/IT placed under the government’s vision 2020 plan (Mohan & Raja Yaacob 2004; Sibte et al. 1998). The healthcare reform initiative, known as the Telemedicine Blueprint under the Multimedia Super Corridor (MSC) Telehealth project, has been launched since 1997 to reform the Malaysian healthcare system (Sibte et al. 1998). The focus of the future healthcare system will be on people and services, where the use of technology will act as the key enabler to provide an accessible, integrated, high-quality and affordable healthcare system that is recognised as one of the world’s best (Mohan & Razali Raja Yaacob 2004).

There are currently 135 public hospitals in Malaysia with 18 referral and tertiary hospitals equipped with a partial or fully integrated HIS since the Telehealth initiative was launched more than a decade ago (Li 2010; MOH-Malaysia 2010). This indicates a very slow progress on the healthcare IS/IT reformation in Malaysia. It is important for the public hospitals to perform efficiently whilst providing excellent services to the public as
the revenues from general taxation have been used to subsidize health services (Chee & Barraclough 2007). Hence, it is important to investigate the issues of IS/IT assimilation in Malaysian public hospitals, and to investigate whether the HIS use in Malaysia is problematic, and what could be done to successfully assimilate the HIS technology in a Malaysian public hospital.

The next section will discuss the challenges and issues of implementing HIS in Malaysia, a developing country which claims to have achieved remarkable advances in healthcare delivery and has identified that the future of healthcare includes technology playing a key enabling role (Ghani et al. 2008; Merican & Yon 2002; MOH-Malaysia 2010; Mohan & Razali Raja Yaacob 2004).

2.4 The Malaysian Healthcare System

Malaysia is a developing country in the Southeast Asian region with a current population of approximately 26 million people, a nominal per capital GDP of US$8,100 in 2009 and an approximate total expenditure on health as a % of GDP of 4.3 (WHO 2009). The country consists of thirteen states and three federal territories which were under the influence of the British colonialism until 1957 (Liu et al. 2002; Tourism-Malaysia 2009). The healthcare system in Malaysia is influenced by the modern westernized method, however there exists traditional methods subscribed to especially by the indigenous people of Malaysia, and other medical practices such as herbalist and healers of Arab, Indian and Chinese ethnicity (Chee & Barraclough 2007). The Malaysian healthcare system consists of both a public and a private sector. The rural areas are mostly served by government health clinics and hospitals (UNICEF 2006; WHO 2006).

With the major influence of colonial states, western medical practices have predominated and have been the major medical approach practiced in the various states (Chee & Barraclough 2007). General hospitals have been established in each of the states since 1910 and currently the healthcare services are almost fully funded by the federal government through the national budget (Chee & Barraclough 2007). Figure 4 depicts a simplified hierarchy in the Malaysian Ministry of Health (MOH), a government body that
provides control over the public health division in Malaysia. The detailed picture of the Malaysian Ministry of Health’s organisation chart can be found in Appendix 2.

From the original MOH’s organisation chart, there is an indirect monitoring between the Director of General Health from the federal government to the State Health Institute Directors. This indicates that the federal government still provides a centralized control over health policy by using its constitutional powers to take over the health functions exercised by the states (Chee & Barraclough 2007).

Figure 4  Malaysian Healthcare Organisation Structure (MOH-Malaysia 2010)

One of the outstanding features of the Malaysian government’s hospitals adopted from the British is the civil service benefits where civil servants are entitled to free or heavily subsidized hospital care and privileged to different classes of services according to ranks (Chee & Barraclough 2007). However, the general public could also seek free or heavily subsidized inpatient and outpatient care or choose to pay more for higher class wards (Chee & Barraclough 2007; MOH-Malaysia 2010).
The world economic crisis in the late 1970s caused by the rise in oil prices and falls in prices of raw materials and goods led to a fiscal and debt crises in developing countries. As a result, direct healthcare provision by governments and privatisation of certain components in the government health service in Malaysia were limited (Chee & Barraclough 2007). The economic crisis also led to the reformation of the healthcare industry in the 1980s to shift from a welfare-orientation and reliance on state institution towards a focus on market mechanisms and the role of the private sector (Chee & Barraclough 2007). There were also international influences on government policies which support the growth of private sector and this resulted in a much more complex healthcare system (Wee & Jomo 2007). Hospital sectors then experienced the rapid rise of the corporate, investor–owned entity and growing presence of specialist clinics (Wee & Jomo 2007).

The reformation of healthcare systems in Malaysia included (Chee & Barraclough 2007):

- universal access to government hospitals funded largely from general taxation
- a strong civil service culture in the public healthcare services
- a rigid hierarchy in terms of the accommodation entitlement of different categories of patient

Financially, the use of private sector medicine has led to the rise of out of pocket payments, an increasing uptake of health insurance and the development of managed care organisations (Wee & Jomo 2007). Currently, the Malaysian government is in the process of working out details for a proposed national health financing scheme that will transform the current taxation-based system into a social insurance system (Chee & Barraclough 2007). Whether or not supplementary private financing is required and how much is needed would depend on the extent of population coverage as well as the breadth and depth of services covered (Chee & Barraclough 2007).

2.4.1 Issues with Malaysian Healthcare Systems

A new privatization policy was announced during Prime Minister Mahathir’s administration in the wake of sustained economic growth in 1983, which caused the state to cooperate and foster relationships with the private sector (Wee & Jomo 2007). This
caused major issues as most of the hospital systems that existed was not able to create this relationship as at that time, there were few private hospitals and there was a lack of capital for hospital expansions (Wee & Jomo 2007). The government hospitals held a very highly regulated civil service culture that led to inefficiency within the support services, including maintenance and waste disposal (Chee & Barraclough 2007). Another major issue was the concept of welfare through heavily subsidized or free care to patients that was no longer seen as a public entitlement but as a burden to the government as it causes depletion of public funds due to escalating costs and an undesirable legacy from colonial rule (Chee & Barraclough 2007).

The increase in expenditure and priority given by the government to the health sector can be traced all the way back in the mid 90’s where there exists privatization of certain services in healthcare (Chee & Barraclough 2007). The Ministry of Health subcontracted its hospital support services to the private sector and has caused the escalation in the MOH expenditure (Chee & Barraclough 2007).

Moving forward into the present millennium, the basic structure of Malaysian healthcare remains a mix of private and public sectors. The ratio of public to private doctors has fluctuated from 42:58 in the mid 80’s to 54:46 in 2000 (WHO 2006). This was mostly caused by the enormous growth of private hospitals providing attractive alternatives to public medical staff (Chee & Barraclough 2007). The government has the idea of removing the medical sector from the civil service, which will enable salary structures to rise above the levels permitted for civil servants (Chee & Barraclough 2007). This leads to corporatizing the government hospitals, which will potentially increase user charges considerably as seen in one of the corporatized Malaysian National Heart Institutes (Chee & Barraclough 2007). Malaysia is fast transforming into an ageing society, due to a slowing birth rate (UNICEF 2006). The country lags behind in planning and providing for an aging population particularly in terms of aged care facilities and healthcare expertise. Geriatric services in many rural areas are unavailable (Chee & Barraclough 2007).

Inequities also exist in the distribution and utilization of healthcare services by geographical location, states and social class (Wee & Jomo 2007). This is reflected in the
government’s prioritization of healthcare expenditure in which the physical distribution of government health services by stratum and state is inequitable (Wee & Jomo 2007). This affects access and utilization for lower income groups (Wee & Jomo 2007). The current total federal government health expenditure increased from MYR 8,693 million in 2006 to MYR 11,753 million in 2009 (Treasury-Malaysia 2009). There was a misallocation of funds by the government with a major proportion of funding to the private subcontractors rather than improving the health service quality or coverage (Chee & Barraclough 2007).

Other issues with Malaysian healthcare in government hospitals are the travel, waiting time and treatment time for an outpatient visit (Wee & Jomo 2007). The location of health facilities, being generally located further from the poor increases travel time and cost and thus reduces the demand for health services to the poor because of difficulties with getting paid sick leave and loss of income for the self-employed (Wee & Jomo 2007).

Waiting time for treatment has been a greater deterrent than travel time (Heller 1976). This is due to the lack of doctors in the relatively poorer states (Wee & Jomo 2007). Hence, people in rural populations bypass government facilities to seek better treatment in private facilities. Nonetheless, not all of the poor who require treatment can afford to seek private treatment due to travel and opportunity cost (Wee & Jomo 2007). The private sector concentrates mainly in urban areas providing access to those who can afford to pay higher fees thus leading to inequitable distribution of health services and resources (Merican & Yon 2002). Therefore, it is unclear to what extent the poor have benefited from the subsidies when comparable to the benefits enjoyed by the higher income bracket (Wee & Jomo 2007).

The equity obligation has to be fulfilled by the government as the revenue from general taxation has been used to subsidize health services. Therefore it is imperative that the government works its way in providing essential services and achieve the equity objective to provide better healthcare services.
2.4.2 Information Systems in Malaysian Healthcare Context

The Malaysian healthcare system comprises of the Ministry of Health as the main healthcare provider with public hospitals, general practitioners as well as private healthcare facilities (Kumar, Krupinski & Abdullah 2008). There are more than 200 private hospitals and approximately 5000 general practitioners excluding those operated by the Non-profit Government Organisations (NGO), hence it is rather predictable that personal health data is scattered and unorganized (Li, J 2010). To overcome this issue there are several projects developed by the Malaysian government with the aim of promoting and maintaining the wellness of Malaysians and to provide greater access to healthcare information. Such projects include the National Telehealth Policy (Kumar, Krupinski & Abdullah 2008). This project comprises of four exciting initiatives for IS/IT such as Teleconsultation/Telemedicine, Mass Customised/Personalised Health Information and Education (MCPHIE), Lifetime Health Plan (LHP), and Continuing Medical Education (CME) (Kumar, Krupinski & Abdullah 2008; Li, J 2010). This project was launched as the government foresees the need to transform the Malaysian healthcare system in order to overcome the challenges of rising healthcare costs, changing patterns of disease, rural—urban migration, increased life expectancy and increased expectations of consumers (Mohan & Razali Raja Yaacob 2004). Among the 4 initiatives, teleradiology is seen as the most evolving branch under telemedicine. Teleradiology uses computers and telecommunication networks in exchanging images and data from one location to another for specialist consultation (Bulgiba 2004; Kumar, Krupinski & Abdullah 2008). Using teleradiology has enabled Malaysia to open its first paperless and filmless hospital in 1999 with the establishment of a Total Hospital Information Systems (THIS) (Kumar, Krupinski & Abdullah 2008).

2.4.3 Total Hospital Information Systems (THIS)

The Total Hospital Information System (THIS) is a computerized hospital information system aimed at providing a paperless and filmless environment (Selayang-Hospital 2010). The central objective of having THIS is to provide an integrated care delivery system capable of information sharing, automation of work processes, provide greater efficiency, better storage of data and use of data for relevant medical statistical or research purposes. Further, the THIS was also aimed at providing easy access of data,
data sharing among providers while improving patient safety in the management of illness, provide better record management and security as well as improving workflow through the reengineering of work processes (Kumar, Krupinski & Abdullah 2008)

The THIS project was first launched in Malaysia in late 1999 as a direct result of the Prime Minister's vision for Malaysia becoming a developed country by the year 2020 (Kumar, Krupinski & Abdullah 2008; Salleh 2003). This vision included various IS/IT initiatives that included a healthcare information technology reformation. It was the aim of Malaysia to be the first in the world to have a single HIS which covers all aspects of hospital’s operation, both clinical and non-clinical. The development of THIS was made from a mix and match product of multiple vendors integrated together in a complete HIS for the hospital. Two of the vendors involved with the THIS development and implementation were CERNER and SIEMENS. A group of enthusiastic medical professionals, including heads of departments, specialists and medical administrators, sought relevant information from worldwide sources through a series of meetings, discussions and visits to hospitals in order to gain insight into the specifications for a hospital with an efficient and effective information system (Salleh 2006).

An efficient and effective hospital information system basically covers all aspects of the clinical processes as well as management and administrative functions in areas of administration, finance, office automation and communications. The functions of THIS included appointments and scheduling of patients, patient registration, admission, discharge and transfer as well as the management of clinical data documentation. This includes administration, patient monitoring and charting, diagnosis documentation and outcome documentation. THIS was also developed to cater for ordering tasks and tests, ordering drugs and supplies, entering results of procedures and tests, viewing results and referral of patients.

Waiting time, identified as one of the major issues in a non-computerized hospital, was the targeted for improvement by a fully computerized hospital as was the reduction in patient admission waiting time (Salleh 2006; Wee & Jomo 2007). The computerization of the hospital information system was also aimed at reducing length of patient stay, reduction of patient discharge processing time, faster processing time in viewing x-rays,
gaining efficiency in scheduling patients’ appointment and reducing the time of viewing and retrieving of the patient’s record (Salleh 2003).

The THIS has been designed to provide numerous values to the healthcare community and indirectly provide benefits to the patients. These benefits include knowledge transfer and knowledge management with technology, which allows junior medical doctors to learn from specialists using the tools provided to them anytime, and anywhere (Li 2010). The patterns of standard treatment and diagnosis for common illness can be generated from the data stored in the system. The system also provides better patient safety in terms of storage of their medical records which eliminates the issue of missing data and patient’s medical records. To further enhance the reliability of the system, security mechanisms were incorporated in addressing accessibility issues through the use of passwords and controlled logins (Salleh 2003, 2006)

2.4.4 Issues with Malaysia’s Information Systems in Healthcare

There are several issues with the information systems implementation in Malaysia, driven by an inadequacy of skilled human resources to operate and maintain the technology. Lack of in house technology, insufficient experience in the use of IS/IT in healthcare and the attitudes of some healthcare staff also contribute to the issues to be resolved (Bulgiba 2004). The government initiative involving telemedicine is currently being used in selected hospitals and is heavily criticised to be just a technology. Teleradiology is also criticised for its massive capital costs and difficulty in obtaining sufficient bandwidth (Bulgiba 2004; Merican & Yon 2002). Hospitals implementing the THIS are having integration issues with multiple vendors implementing different versions of THIS in different hospitals, which also creates issues with lack of expertise (Li 2010; Merican & Yon 2002; Mohd & Syed Mohamad 2005). It has also been highlighted by Bulgiba (2004) that there should be one body that ensures that the standards are set and followed by the implementing hospitals. However, this would only result in computerised hospitals and not the achievement of the ultimate HIS on a national scale (Bulgiba 2004).

Coping with change is another issue that has been highlighted as a major challenge in the implementation of information systems in hospitals. Changing the mindset of
healthcare staff to transform from a paper driven environment to a paperless environment can be difficult (Bulgiba 2004). Underlying staff attitudes are primarily affected by insufficient training or formal health informatics courses made available in medical schools which in turn may lead to resistance to technological changes (WHO 2006). To lessen the likelihood of staff resistance, it would be beneficial if universities and medical schools could prepare themselves to this new challenge by incorporating elements of health informatics in their curriculum. Universities could also assist the government in better planning and implementation of the HIS projects (Bulgiba 2004).

In summary, the factors highlighted by Bulgiba (2004) when considering embarking on computerisation in the healthcare industry are:

i. Training
   Training should be offered throughout the year in a hospital in order to provide familiarity and awareness. There should be formal training and courses in medical informatics for all clinical and non-clinical staff.

ii. Development of in-house technology
   Relying on international vendor software could lead to insufficient skills and knowledge by local hospital staff in troubleshooting which would then lead to increasing the cost of overseas vendor support and maintenance. There should be more in-house development to enhance local IT skills and experience as well as reducing cost.

iii. A coordinating body and question of standards
   A coordinating body should act as a point of reference where all vendors and technology implementers will refer to the standards of technology implementation and synchronization in order to provide better facilities for future integration.

iv. Process reengineering
   There is a need to provide involvement from people who are end users at the very early stage of technology implementation and planning. To change the mindset of those who have been using the same work processes for a number of years may be very challenging. The change of work processes must be done with great care and
proper planning especially in highlighting the benefits of the new work processes in order to impress the users and help the acceptance of the new change.

The implementation of the Malaysian IS/IT in healthcare requires a realistic assessment, especially in producing very clear policy, a committed leadership, an efficient implementation program, and the right technology frameworks which recognize that the technology is an enabler and not the ultimate solution (Kumar, Krupinski & Abdullah 2008). Projects with similar initiatives have been undertaken elsewhere in the world and have proved to be successful. In Malaysia’s case, even though the technology is available, the selected technology may not be organisationally, socially or even politically possible (Kumar, Krupinski & Abdullah 2008).

2.5 Implications of Literature to this Study

This literature review has identified various issues pertaining to implementing HIS successfully in healthcare contexts - issues such as technology usage in hospitals around the world and the difficulty in making HIS a success among clinical and non-clinical medical professionals. Successfully assimilating HIS is said to be particularly useful in solving healthcare organisation’s problems in adopting and institutionalizing HIS. Therefore, it is necessary to explore the possibility that assimilating HIS using a systematic approach would actually result in the sustained use of HIS in the healthcare facility. The clinical and non-clinical medical professional’s daily activities being aligned with the objective of the HIS applications should also be explored. It is also anticipated that the level of enthusiasm amongst healthcare professionals would also be sustained throughout the assimilation process as the HIS is being institutionalized as part of the healthcare organisation’s value chain activities.

The previous sections have also presented an overview of different theoretical views, backgrounds and frameworks that discussed the relationship between the assimilation stages with components involving technology, organisational and environment context, and the assimilation gaps. Section 2.5.1 will discuss the development of a more specific conceptual model tailored to healthcare settings. This model will be developed using the technology innovation assimilation perspective which evolved from the diffusion of innovation theory (Fichman & Kemerer 1999; Rogers 2003a), Technology-Organisation-
Environment (TOE) framework and IS/IT resource perspective of the resource based view theory.

2.5.1 Development of the Conceptual Framework

This conceptual model is developed to present a theoretical basis to answer the research question of “How would a systematic focus on assimilation facilitate hospitals in sustaining the use of HIS?” It also identifies the assimilation stages and different components of technology, organisation and environment which act as facilitators to the success of the HIS innovation assimilation which then leads to HIS. This model is derived from a combination of previous work done by Huang et al. (2006) and Zhu, Kraemer & Xu (2006), and is consistent with the classic conceptual work of Tornatzky & Fleischer (1990), Rogers (1983), Thompson (1965), Zmud (1982) and Grover & Goslar (1993).

Assimilation in this research refers to the series of stages that the healthcare organisation has to undergo from the initial evaluation of the potential system to be acquired to the formal adoption and finally to the deployment of the system after which it becomes part of the healthcare organisation’s value chain activities. This research argues that new technology such as the HIS is introduced into a healthcare organisation with great enthusiasm and rapid acquisition but nevertheless fails to be thoroughly deployed and sustained use amongst healthcare professionals. As suggested by Fichman & Kemerer (1999), the widespread acquisition of an innovation will not necessarily be followed by a widespread deployment and full utilization by the acquiring organisation. An assimilation gap exists between the rate of acquisition and deployment, where certain barriers are claimed to have slowed the innovation diffusion process and caused a negative impact on deployment when compared to the acquisition (Fichman & Kemerer 1999).

The conceptual model evolved from this research deals with successfully assimilating and sustaining the use of HIS especially when the new innovation becomes a norm in the adopting organisation (Greenhalgh, Robert & Bate 2008). The proposed conceptual model will also account for the assimilation stages and components that consist in technology, environment and organisational contexts, in addressing issues with assimilation and sustaining HIS usage.
2.5.2 The HIS Assimilation Stages

Previous studies on technology assimilation have outlined a number of assimilation stages for success. These stages vary in their interpretations and can be presented in three stages or six stages depending on the technology innovation involved. Studies by Cooper & Zmud (1990) highlighted six stages from initiation and adoption as the “early stages” and adaptation, acceptance, routinization and infusion as the “later stages”. Zhu, Kraemer & Xu (2003) identified three stages involving initiation, adoption and routinization which covers most aspects of technology innovation assimilation stages. Applying the innovation assimilation concept to the healthcare setting, some researchers have classified the early assimilation stage as awareness and evaluation (Meyer & Goes 1988). However, this study will adopt the view of Zhu et al. (2006) and Ammenwerth et al. (2005), in classifying both awareness and evaluation in the initiation stage in line with the
conceptual framework of Thompson (1965) and many other empirical researchers (Agarwal, Tanniru & Wilemon 1997; Chengalur-Smith & Duchessi 1999; Cooper & Zmud 1990; Gallivan 2001; Grover & Goslar 1993; Pierce & Delbecq 1977; Zhu, Kraemer & Xu 2006; Zmud, Robert W. 1982) which considers ‘initiation’ to be the first stage in an assimilation stage.

Figure 6  HIS Assimilation Stages

Subsequent to initiation is the adoption stage, where adoption involves the successful usage of the technology acquired (Agarwal, Tanniru & Wilemon 1997). A gap is identified between the stages of acquisition and adoption as there is usually the enthusiasm of acquiring new technology. Once it has been adopted however, the new technology failed to meet its purpose and was not able to sustain its use (Fichman & Kemerer 1999). Therefore, adoption does not always indicate that the technology has been widely used in the organisation; adoption has to be followed by the utilization and institutionalization of the technology throughout the organisation (DeLone & McLean 1992; Devaraj & Kohli 2003; Sethi & King 1994; Zhu, Kraemer & Xu 2006). Having found similarities in the assimilation concepts of this research to the study of Zhu, Kraemer & Xu (2003), the HIS assimilation stages described in this research go beyond the initiation and adoption stage to include routinization. This stage refers to the “later stage” of innovation diffusion to a point where the elaborated use of the HIS has become part of the value chain activities of the organisation and managerial systems (Pongpattrachai, Cragg & Fisher 2009; Zmud, Robert W & Apple 1992).
There exists another gap between adoption and routinization which is highlighted after a new information technology has been adopted. The adoption-routinization gap occurs when the organisation and its members lack sufficient knowledge to gain control and manage the system, thereby causing asynchrony with the fit between the technology implemented and the end user’s work context (Fichman & Kemerer 1999; Zhu, Kraemer & Xu 2006). As a result, the system is rarely used and may be totally abandoned. Considering the theoretical aspects and literature above, the conceptual model will account for the three innovation assimilation stages: initiation, adoption, routinization and the assimilation gaps which will be explored in the healthcare setting as depicted in Figure 6.

2.5.3 The Technology-Organisation-Environment (TOE) Context

The conceptual model will include several concepts identified from the TOE framework namely those which have been identified to be relevant when studying developing countries. Among the selected concepts are regulatory environment, technology readiness elements, firm size and managerial obstacles.

Figure 7  HIS Assimilation Facilitators
a) Regulatory environment

Regulatory environment is an important concept to consider in this research as this study involves a healthcare setting in Malaysia, where the federal government has centralized control over the country’s health policy through its constitutional powers. Hence the healthcare organisations must abide to any regulatory changes and implementation (Chee & Barraclough 2007). These impacts might involve elements such as support and funding provided for technology adoption (Chee & Barraclough 2007).

b) Technology readiness

Technological readiness involves infrastructure, relevant systems, hardware and technical expertise which are considered important factors for successful IS/IT adoption (Armstrong & Sambamurthy 1999; Kwon & Zmud 1987). This concept is very similar to the concept of IS/IT resources in the resource based view theory. Hence, this research will merge the TOE technology readiness concept with the IS/IT resources concepts from a combination of resource based view literatures that relates to the influence of resources on organisation’s processes. (Bharadwaj 2000; Grant 1991, 1995; Huang et al. 2006; Khatri 2006; Ross, Beath & Goodhue 1996).

Based on studies done by Grant (1995), Ross et al. (1996), Bhadrawaj (2000) and Huang et al. (2006) the identification of resources for this research will include all of the three common resources from these authors (IS/IT Infrastructure, human IS/IT resources, IS/IT enabled intangibles) in the conceptual framework. These resources are deemed significant in assessing the influence that the IS/IT resources could provide to the HIS innovation assimilation. Exploring how IS/IT infrastructure, human IS/IT resources and IS/IT intangibles are being utilized, and how they can be leveraged in sustaining the use of HIS is relevant to this study.

Another concept that is specifically relevant to managing IS/IT is IT governance. Many organisations, including the healthcare industry, adopted IT governance to ensure that IS/IT is aligned with organisation goals and objectives (Cater-Steel & Tan 2005). As an integral part of enterprise governance, IT governance consists of leadership, organisational structures and processes that ensure the organisation’s IS/IT sustains and extends the organisation’s strategy (Sallé 2004). In order to sustain the use of technology,
there is a necessity in establishing some order and control in the management of IS/IT resources (Zachman 1987). Hence, in managing IS/IT resources, effective IT governance is required. Therefore this element will also be included in the technology context of the conceptual framework.

c) Firm size and managerial obstacle

The firm size concept is incorporated in this framework due to its importance for innovation diffusion (Rogers 2003b) and to distinguish between activities that are carried out between large and small firms in each of the assimilation stages according to their resource advantage (Zhu, Kraemer & Xu 2006).

The managerial obstacles under the organisational context are also considered an important concept as the success of innovation implementation will not only rely on the innovation itself and the behaviour of the adopters, but also on the strength and support provided by the management (Attewell 1992; Greenhalgh, Robert & Bate 2008; Yetton, Sharma & Southon 1999; Zmud 1984). The managerial skills and efficiency of the management in handling change could determine the effectiveness of the innovation assimilation and thus also lead to sustained use.

2.6 Summary and Significance of Study Based on the Literature

The literature has indicated various issues pertaining to IS/IT assimilation and use in the healthcare industry. Malaysia is facing similar problems and the federal government has attempted to solve these issues by initiating national healthcare initiatives and strategic plans for the benefit of the people. One such initiative is to implement hospital information systems that would ultimately lead to a national HIS implemented throughout the country. This research explores issues relating to the way that HIS are currently being assimilated and identifies reasons justifying the importance of HIS assimilation. Issues with HIS assimilation are said to be potentially solved if there is a systematic approach to assimilation with the support of the facilitating components. The literature also identified gaps especially in the assimilation stages where clinical and non-clinical medical professionals tend to be enthusiastic about using the HIS at the beginning of its acquisition and the excitement tends to drop after its adoption. Furthermore, mismatch of the HIS technology implemented with the work environment of the clinical
and non-clinical medical professionals as well as the lack of knowledge in maintaining the HIS are also considered facilitators and contributors to the assimilation gap.

This research is focused on identification and resolution of contras to successful HIS assimilation, through a systematic investigation guided by the development of an HIS assimilation model. The literature review has provided evidence that there is a need for a solid and robust assimilation model to ensure the success of HIS assimilation. This is crucial in assisting the clinical and non-clinical medical professionals to deliver better healthcare services to the community and realize the full benefits HIS has to offer.
CHAPTER 3

3 Methodology & Research Design

This chapter describes the research methodology and research design used in this study to achieve the research objective of developing an HIS assimilation model for hospitals to successfully assimilate and sustain the use of HIS in Malaysia. The achievement of the research objective will thus answer both the major research question and sub-questions of:

*How can a systematic focus on assimilation facilitate sustained use of healthcare information systems (HIS)?*

*Why is assimilation of HIS important? Why are HIS generally poor with regard to sustained use?*

This chapter deals with issues relating to the research methodology and design of the study and argues their justification. This chapter will be organized into 6 main sections describing the methodology in Section 3.1, interpretive research in Section 3.2, case study approach in Section 3.3, the research design in section 3.4 which describes the participants, interviews and analysis. The steps taken to obtain ethics approval and all the necessary research ethics consideration will be discussed in section 3.5, and finally summary of this chapter will be in section 3.6.

3.1 Methodology

This research is exploratory in nature with the aim of exploring well formulated theories in a unique context that in turn leads to confirming, challenging and building upon these theories. Hence, a qualitative approach is deemed especially appropriate in studying a relatively new phenomenon, that a specific population experiences; a new innovation in a particular context. Especially for this research, a qualitative approach is suitable in exploring the research problems through the point of view of participants describing their issues and problems explicitly whilst using the HIS. This research also involves the study of social and cultural phenomena through interviews, documents and the researcher’s impression as well as reaction to the identified context (Myers 2009). Qualitative research
is designed to understand people and their social and cultural context within their environment and it is believed that the point of view of the participant and their institutional context is largely at loss when textual data are quantified (Kaplan & Duchon 1988).

Many social scientific studies in the area of IS/IT implementation in healthcare settings use quantitative methodologies to assess impacts, effectiveness of systems, impact on cost, services and user satisfaction (Lee & Wan 2003; Marino & Tamburis 2005; Bhattacherjee, A & Hikmet, N 2007; Reardon, J & Davidson, E 2007; Lee & Shim 2007). The use of a qualitative approach is deemed suitable in areas involving the deployment, experience and usage of medical IS/IT as it provides critical insights and in-depth study of users experiences (Murphy et al. 1998; Mantzana et al. 2007; Barnes 2001; Katsma et al. 2007). Studies of organisational process, context and culture where the focus of the study is on adoption, assimilation and usage of an innovation, often also adopt qualitative methods (Greenhalgh et al. 2004).

Qualitative research methods of many kinds such as case studies, ethnography and grounded theory have been increasingly applied in many general healthcare and health information system research, (Barnes 2001; Chew-Graham, Maya & Perry 2002; Jensen & Aanestad 2007; Jha et al. 2008; Lundberg & Hanseth 2001; Mantzana et al. 2007; Mercer 2001; Ramani 2004; Yusof et al. 2008). People in the medical industry namely the management, clinical and non-clinical staff are showing great interest and willingness to face the proactively imminent modern IS/IT in order to gain better social, economic, management and organisational balance (Marino & Tamburis 2005). For this research, there was much to explore on the influence of organisational, environment and technology components on assimilation process, hence the qualitative research methods were employed as they support the investigation of a little known phenomena and complex processes in their natural setting (Mantzana et al. 2007).
3.2 Interpretive Research

Research epistemology involves the way in which knowledge is understood (Cavaye 1996). Orlikowski (1991) suggested three categories, based on the underlying research epistemology to be positivist, interpretivist and critical. Guba and Lincoln (1994) suggested four underlying epistemologies for qualitative research which are positivism, post-positivism, critical theory and constructivism. The classification by Orlikowski (1991) is most commonly used in IS research as compared to the definition described by Guba and Lincoln (1994). However, while the research epistemologies are philosophically different, in the practice of social research these differences are not always so clear cut (Lee, AS 1989) especially with interpretivism and positivism where both epistemologies rely on different assumptions about the nature of knowledge and requires different approaches to research (Cavaye 1996).

Since this research focuses on answering how a healthcare organisation sustains the use of the HIS facilitated through a systematic focus on assimilation, hence the usage of an interpretive research approach is deemed suitable (Myers, M 2009). This is due to the nature of interpretive research where it attempts to understand phenomena through the meanings people assign to them (Myers, M 2009). Interpretive research is also aimed at producing an understanding of the context of IS/IT and the process whereby the IS/IT influences and are influenced by the context (Walsham 1993). Although the research employs the use of a conceptual model as part of the research design, the elements identified through the literature are not considered as predefined dependent or independent variables, but taken as a guide for data collection and to provide a relevant boundary to this research. Therefore, in line with the argument of Kaplan & Maxwell (1994), interpretive research does not predefine dependent and independent variables, but focuses on the full complexity of human sense making as the circumstances appear through the data collection process.

This also supports the work of Eisendhart (1989) where the use of theory in interpretive studies has been categorized into: an initial guide to design and data collection, as part of an iterative process of data collection and analysis, and as a final product of the research. Since this research would like to gain an extensive understanding of the HIS assimilation
through the innovation assimilation theory and the TOE framework in combination with the resource based view perspective, the use of these theories will act as an initial guide to design and data collection towards achieving a more detailed and insightful explanation of the study (Walsham 1993, 1995). The identified theories were used in a very cautious manner, in order not to allow the research to be too rigid in only seeing what the theories suggest (Walsham 1995). An open mind was kept throughout data collection and analysis in order to avoid bias. This in turn facilitates the discovery of new themes and areas for exploration leading to modification of initial assumption which leads to confirming or refuting all or parts of the identified theories (Walsham 1995).

3.3 Case Study

A case study is the appropriate research method in this study as it allows the researcher to obtain the “insider view” of the selected organisation, thus enabling a better understanding of the current organisational status directly from informants within the organisation (Fletcher & Plakoyiannaki 2011; Yin 2003). This then leads to a more in-depth and holistic picture of the studied phenomenon (Yin 2003). There are various designs for case studies which include a holistic single case design, embedded single case design, holistic multiple case and embedded multiple case (Fletcher & Plakoyiannaki 2011; Yin 2003). For this study an embedded single case design was used as the case selected is considered an exemplar and critical case in testing well formulated theories. In the area of healthcare information systems research, a case where the healthcare organisation has undergone a series of HIS assimilation stages for a significant number of years up to a routinization point is considered as a critical case. In this manner, the choice of the exemplar case in combination with the three chosen theories would represent a significant contribution to knowledge and information systems assimilation theory building. Adopting a critical case would also result to refocus future investigations in an entire field of HIS in other context (Yin 2003).

This research adopted a single case study approach with more than one unit of analysis embedded within the case. One of Malaysia’s public hospitals which have had a significant number of years assimilating an HIS was selected as the case for this study. This hospital provides an excellent setting for this study as the phenomena under study
are present at various levels in the organisation. This supports Yin (1981) and Eisendhart’s (1991) argument that contrasting observations from several units of analysis within one case can create and highlight theoretical constructs. A major reason for the choice of this hospital as the single case study was that in studying assimilation of IS/IT, this involves a number of stages from initiation, to adoption and finally to routinization. Hence, looking for a hospital already utilizing IS/IT throughout the entire hospital and adhering to a specific timeframe is crucial. A Malaysian public hospital which will be known as the Alpha Hospital in this research was designed, constructed and equipped for an end-to-end hospital wide IS/IT environment using an integrated information system for both clinical and non-clinical operations. This hospital is seen as the best choice as it was the first hospital in Malaysia built to operate with hospital wide computerization covering all aspects of its operation. It is anticipated that a number of implications would be derived from this exemplar case study as the assimilation of HIS in this public hospital has gone through a number of phases for the last 11 years.

The common question when adopting a single case study approach would be “How can you generalize from a single case study”? A common misunderstanding among scholars is that one cannot generalize on the basis of a single case; therefore, the case study cannot contribute to scientific development (Flyvbjerg 2006). In answering this, Yin (1981) states that case studies are indeed generalizable to theoretical proposition and depending on how the case was chosen as well as the criticality of the case (Flyvbjerg 2006). This research also takes on the interpretivist view, where Walsham (1995) further extends this answer by claiming that interpretive case studies can be generalized through the development of concepts, generation and/or refinement of theory, drawing of specific implications and contribution of rich insights. To further strengthen the stand on adopting a single case study, this research also supports the argument of Markus (1989) where single cases may also be used for theory testing and disconfirming theory.

3.4 Research Design

This research has employed a variety of data collection methods in order to obtain a better depth of the study. The methods include interviews, researcher observation and
document analysis. Figure 8 illustrates the design of this research from the identification of the research problem to the submission of thesis.
Figure 8  Research Design
3.4.1 Participants

Participants for this interview were categorized into pilot study participants and main study participants. There were 2 participants for the pilot study and 31 participants for the main study conducted at the Alpha Hospital. The participant for the pilot study was a medical specialist from the Alpha Hospital and a subject matter expert on information systems in healthcare. The pilot study was conducted in order to gauge responses on the suitability of the interview questions and preliminary insights on the issue of HIS use in the selected case study.

The main study was conducted in Malaysia based on the criteria of the hospital being the first to implement a hospital wide IS/IT and have undergone every stage of the HIS assimilation. The participants for the main interview were recruited across multiple departments in the hospital ranging from senior clinicians who participated in the planning of the HIS at the Alpha Hospital, to the junior medical team as well as the non-clinical personnel.

The participants were approached after permission was sought through the hospital’s Deputy Director of Medicine with some names being suggested as the point of contact for the relevant department. Participants were mostly contacted via email and appointment was scheduled according to the participant’s availability. The participants were given a Plain Language Statement describing the research using simple English language and a consent form to guarantee anonymity while participating in the interview. The consent form also asks if the participants were comfortable having the interview recorded and the recordings will only be used by the researcher only for the purpose of analysis. These documents were presented to the participants prior to the interview. A copy of the interview questions and Plain Language Statement that was given to the participants before the interview can be found in Appendix 3. Table 7 summarizes the pilot and main data collection details.
Table 7 Data Collection Details

<table>
<thead>
<tr>
<th>Type of Study</th>
<th>Number of interviewee</th>
<th>Positions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pilot</td>
<td>2</td>
<td>Medical Personnel Subject Matter Expert</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Paediatrics RMIT</td>
</tr>
<tr>
<td>Main</td>
<td>31</td>
<td>Clinicians, non-clinical staff, management</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Director’s Office Hand and Micro Surgery Pharmacy Dermatology Otolaryngology Gynaecology Laboratory Services/Pathology Admissions Paediatrics Information Technology Department Emergency</td>
</tr>
</tbody>
</table>

3.4.2 Interviews

Interviews are suitable to be used in this qualitative research as it requires a technique that includes the capacity for accessing respondents’ definition and interpretations of the phenomena under study (Murphy et al. 1998). As this research aimed to gather rich insight into the experiences of the HIS users, the interview approach was used to understand how the respondents understood their world. The interview was also aimed to uncover respondent’s perspective on the way the HIS was implemented and used in the hospital. The researcher acted as an outside observer where the interviews were considered as the primary data source to provide the interpretations that the participants have on the events and actions that are taking place in their context (Yin 1994). In viewing the researcher as an outside observer with no particular influence or specific interest from any stakeholders within and outside the hospital, an established rapport allows the interviewees to be frank in expressing their views (Walsham 1995).

This research adopted a semi-structured interview method where the interviews were conducted on the basis of a loose structure consisting of open ended questions. These questions provided a guide to understand areas being explored initially; however, as the interviews progressed, the interviewer and interviewees diverged into other relevant
subjects pertaining to HIS use in order to produce a more detailed description of the issues being discussed (Britten 1995).

Based on the experience of the researcher the semi-structured interview was chosen in order to have a better guide and produce a more informative interview session. The questions in the semi-structured interview were designed adapting the suggested list by Patton (1980) which starts by asking the interviewee about his/her background and demographic details. This is then followed by their opinion, experience, feelings and knowledge about the current HIS use and issues. The semi-structured interview had 18 questions where some questions were merged and devised by the researcher during the interviews in order to provide better explanation and understanding especially to clinical staff who were not very well versed with IS/IT technological terms. All interviewees were given an explanation about the research question, the definition of assimilation and details on the assimilation concepts to obtain more insight and in-depth responses. The interviews were recorded upon approval of the interviewees and notes were taken where necessary. The interviews were mostly conducted in English; however, some of the participants were more comfortable in conducting the interview in both Malay and English language or in Malay throughout the interview. In situations especially involving work culture and political issues, participants were more comfortable in expressing their views using the national language as it provides better detail and adds richness to the issues being discussed. Therefore, in this situation, the interviews were allowed to be conducted in Malay as the comfort of the participant is more important.

In addition to the semi-structured interviews, this research also involved the use of multiple data collection methods such as data, methodological and interdisciplinary triangulation (Denzin & Lincoln 2005; Mantzana et al. 2007). Data was also collected through several other sources such as archival documents, minutes of meetings, consultancy reports and the organisation’s website. It is also the aim of this research to enhance or build upon existing theories through the findings of the data collected. Therefore, this is in line with Eisenhardt’s (1989) suggestion that the usage of multiple
data collection methods supports triangulation and provides a concrete and solid foundation of theory building.

### 3.4.3 Analysis

This section explains the methods used to analyse data for this research. The use of thematic analysis was applied in the analysis of data in this research as it provides a structured way of understanding how to develop thematic codes and sense themes. The interviews were transcribed and themes were identified from the transcription. The analysis was also carried out with the initial conceptual framework in mind at all times.

There are 3 stages involved in the use of thematic analysis. Stage 1 involves deciding on sampling and design issues, stage 2 involves developing themes and codes and stage 3 involves validating and using the codes (Boyatzis 1998). Stage 1 was successfully carried out before conducting the interviews and stage 2 requires specific decision making as there are various ways of conducting the second stage. Upon developing the themes and codes for data analysis, the researcher has to decide between using a theory driven approach, a prior research or prior data driven approach or an inductive approach.

This research adopted the theory and prior research driven approach in developing the themes and codes as this approach allows the use of existing themes and codes in order to replicate, extend or refute prior discoveries (Boyatzis 1998). Moreover, this approach was also chosen due to the flexibility given to researchers who may not have the training or confidence in developing their own codes and may want to rely on established theories to assist in the development of themes and codes (Boyatzis 1998). The themes were first identified from the initial conceptual model, followed by emerging themes such as financial, political and procurement identified through interview transcription. Table 8 reveals the themes and sub-themes identified from the analysis of the issues discovered through the interview transcription.

<table>
<thead>
<tr>
<th>Theme</th>
<th>Sub-theme</th>
</tr>
</thead>
<tbody>
<tr>
<td>People</td>
<td>Clinical IS/IT Experts</td>
</tr>
<tr>
<td></td>
<td>Medical Staff</td>
</tr>
<tr>
<td></td>
<td>Vendor</td>
</tr>
<tr>
<td>Process</td>
<td>IT governance</td>
</tr>
</tbody>
</table>
Responses from the medical personnel were methodically and carefully scrutinized and then categorized into the identified themes. These themes are defined and described in the next section, while the discussion on data interpretation addressing these themes will be discussed in chapter 4 and 5.

### 3.4.4 People and Process

The people and process theme refers to the characteristics and resources of the organisation such as human resources, IS/IT resources, financial processes, procurement processes and governance structure.

Financial processes has been identified as one of the most salient characteristics of having HIS innovation in a hospital setting (Jaana et al. 2006; Paré, Jaana & Sicotte 2009). Much research in the technology innovation adoption in healthcare has also claimed that adequate financial resources, high costs, and calculating return on investment are among the top challenges and significant contribution to HIS technology adoption (Chang et al. 2007; Radhakrishnan, David & Zaveri 2008; Yasunaga et al. 2008). Hence, this research reveals that these issues can be commonly described as a barrier or facilitator towards HIS assimilation.

Human resources are crucial elements to the success of assimilation. The IS/IT resources have been identified to require strong IS/IT competencies and skills in order to be able to solve business problems and handle business opportunities through the use of IS/IT (Ross, Beath & Goodhue 1996). In the next chapters, this research will explain how these IS/IT resources are seen as crucial to HIS assimilation and why they require more than just mediocre IS/IT knowledge.
The IT governance and clinical governance structure are crucial in order to ensure the organisation’s use of IS/IT sustains and supports the planning of the organisation’s strategy so that further requirements and needs can be met (Sallé 2004). The influence of both governance structures on HIS assimilation and issues with the current processes will be described later through the analysis of data and followed by discussion in the next chapters.

3.4.5 Technology

Technology refers to the readiness of the organisation in providing the right infrastructure, relevant systems, technical expertise and other intangible IS/IT related matters concerning the suitable assimilation of HIS. The sub-themes identified for this research have the technology characteristics divided into infrastructure (software and hardware), performance and system design.

Technology infrastructure refers to the physical IS/IT assets that form the IS/IT backbone of the organisation including the communication technologies, shareable technical platforms and databases (Bharadwaj 2000; Ross, Beath & Goodhue 1996). Hence, this research will identify if the hospital’s infrastructure has been expanded to the entire hospital, allowing them to evolve in taking care of the distribution and management of hardware, software, and other support services.

3.4.6 Environment

Environment refers to the higher level issues that surround the hospital administration; namely, in assimilating HIS. Political characteristics refer to any decisions or behaviour of any relevant parties within and outside the hospital which causes an impact towards the assimilation of HIS in the hospital. Since the setting of this research is in a public hospital, therefore the next chapters will also discuss government regulation and how these policies and regulations provided a direct and/or indirect influence to the assimilation of the HIS.

3.5 Ethics

Ethics approval was sought in both the researcher’s academic institution and the responsible ethics institution appointed by the Malaysian Ministry of Health (MOH).
The process of obtaining approval from the researcher’s academic institution was done in
detail especially concerning the way which participants were recruited. The academic
institution was very concerned that all participants should be recruited voluntarily without
any influences or order by their superiors. This presented a minor mismatch with the
common practices of the Malaysian public service work culture where you are required to
seek permission from the relevant superiors in order to speak to their subordinates.
Nevertheless, the institution’s ethics committee was assured that this will not provoke any
form of force or distress to the targeted participants as they still had a choice to either
participate or refuse even after permissions was already sought by their superiors. In this
way, ethical procedures were upheld as well as cultural sensitivities being observed.

The culture of obtaining superiors’ permission is also necessary even with obtaining
access to the selected hospital. Since the chosen hospital is a public hospital under the
government’s ministry; hence, all research done in this facility and jurisdiction has to be
registered and approved by the Ministry of Health (MOH). The researcher did not
communicate directly with the MOH, instead an appointed body known as the National
Medical Research Register (NMRR) provided an online platform for all researchers who
wishes to undertake research in the MOH’s facilities. The process of seeking approval
begins with the research registration with NMRR followed by an intricate series of steps
summarized as follows:

1. The researcher had to download an Investigator Agreement form where the
researcher is required to obtain signature from the Head of the IT department and
Head of Clinical Research Center of the targeted hospital since the research is of
IS/IT in nature involving clinical and non-clinical systems. This is followed by
obtaining the signature of the Hospital’s Director granting permission to conduct
research in the chosen hospital.

2. The Investor Agreement form is now signed and scanned to be uploaded to the
NMRR’s online portal. The researcher then submits the proposed research with
the Investor Agreement form via the online portal to another appointed body by
the MOH known as the National Institute of Health (NIH) which is responsible
for all types of medical research done Malaysia. The NIH has 6 institutes which
reviews different types of medical research. Since this research involves IS/IT in both clinical and non-clinical area, the researcher had to choose the Clinical Research Center (CRC) and Institute of Health Systems Research (IHSR) for their approval. These institutes review the authenticity and novelty of the research project and the human ethics approval is carried out by another institution. Simultaneously submitting to these two institutions the researcher had to also submit to the Medical Research Ethics Committee (MREC) for ethics approval.

3. The process of obtaining approval takes about 3 to 6 weeks, and the researcher was informed via email if the review process has been conducted and if the research is approved or requires modification.

4. Once the submission is approved the researcher was granted with an approval notification by the NIH and MREC in the form of an Institutional Approval document. It is only with this document that the researcher was allowed to enter the targeted hospital and meet the Hospital Director or the Deputy.

This entire process needs to be repeated if the researcher plans on conducting research in another facility of the MOH. The researcher was granted approval a few days before the actual data collection date and was reminded that the institutional approval document was only for the specified hospital.

3.6 Summary

In summary, this chapter has provided an overview on the research methodology to be conducted in this research. It has also outlined the exploratory case study research method adopted and provided justifications for its usage. It also presents the design of the research involving the number of participants, the interview and method of analysis. In ensuring the integrity of the study, this chapter also highlights the steps of addressing ethical concerns regarding the educational institution as well as the research case study environment. The following chapter provides a thorough description of the case study where the research was conducted, the analysis and findings from the interviews.
CHAPTER 4

4 Data & Analysis

This chapter describes the analytical approach and results of the interviews conducted at the Alpha Hospital in Malaysia, which was used as an exemplar case study. The analysis and interpretation of the data obtained from the interviews assists the researcher in assessing their impact on the research question “How can a systematic focus on assimilation facilitate sustained use of healthcare information systems (HIS)?

The outcomes of the analysis and interpretation can then be applied to the research question to elicit an overall picture of the research domain and its proposed implications for assimilation in HIS in Malaysian hospitals.

This chapter will be organized in 7 main sections, describing the case study site in section 4.1, describing the hospital as an operational site in section 4.2, the hospital as a site for HIS assimilation in section 4.3, the units of analysis and their perspective on HIS assimilation in section 4.4, the themes and sub-themes in section 4.5, findings from the case study in section 4.6 and finally summary of this chapter in section 4.7.

4.1 The Alpha Hospital – The Case Study Site

The Alpha Hospital is a government owned tertiary hospital located in the vicinity of Malaysia’s capital city of Kuala Lumpur. The hospital caters for patients seeking treatment at Alpha Hospital and for patients with referral cases from other public hospitals and private medical centres. In terms of its physical structure and interior facilities, the hospital can be considered as relatively new as it commenced operations in 1999. In the first few years of its operations it had an average of 150 inpatient admissions per day and about 1500 outpatient per day. At the time of study the number of inpatient and outpatient admissions per day had tripled. The demographic profile can be described as an ‘average’ South East Asian country, where it is observed to be dominated by the three main ethnic groups of Malaysia that is the Malay, Chinese and Indian. The social class band is observed to be middle to lower income group, which is quite common in many public hospitals in Malaysia. There are occasional cases of patients from other
countries attending the Alpha Hospital, and these patients normally fall into the international patients’ category.

4.2 The Hospital: As an Operational Site

The Hospital operates with a total of 960 beds spread across 5 floors and with a total of 19 clinical departments as listed in the hospital’s organisational chart illustrated in Appendix 1. Due to being relatively new in terms of building and structure, the facilities are quite modern and well maintained. Much of the surrounding areas are developed for medical and non-medical staff accommodation. Other staff facilities include playgrounds, cafes and a car park.

As the number of patients has tripled over the years, there are major issues with parking spaces and public transport is not regular in the area where the Alpha Hospital is built. Patients’ relatives, next of kin, outpatients and visitors usually have to race each other to ‘fight’ for a parking space. The hospital staff with a certain rank would have their parking spaces reserved and those outside of these ranks would also occupy the visitor’s parking. Time of arrival is crucial at this hospital in determining the success or failure of obtaining a proper parking space. On an unfortunate day where the car park is full, the visitors must risk their vehicle to parking summons by the council/police, hit and run accidents or getting towed by parking along the roadside.

Although it seems quite modern the setup of this hospital does not differ much from a typical government hospital and has the following characteristics:

1. Small convenient stores opened by the side of the main entrance as you walk towards the lobby. These stores usually sell food, drinks, toiletries and traditional herbal medicine for the patient, the person looking after the patients or visitors.
2. Motivational slogans and logos printed in large forms on the wall as you are about to enter the main lobby. Slogans such as “We are here to help”, “A smile is a gift” are common slogans and they are made for two reasons; one is to remind the hospital staff to be more friendly and secondly as a way to show customers on customer orientation values of the hospital.
3. The walls are also decorated with information such as the hospital’s organisation chart, list of clinical departments with the names of its head of department and portrait size pictures of the Malaysian King and Queen, the Prime Minister and his wife, and the chief minister of the state.

4. A stand with a reminder note on patient visiting hours. In a Malaysian government hospital you are not allowed to come as you please, due to the visiting hour’s rule where visitors, family members and friends are only allowed to visit a patient from 12 pm to 2 pm and 5 pm to 7 pm and 8 pm to 10 pm every day. Some hospitals may have different time slots but generally those are the common visiting hours.

The lobby was designed to have a patient registration counter on the left and a waiting area on the right of the entrance. As a visitor approaches the central elevator that is used to go up to a patient’s wards, there is a security guard on duty in front of the elevators to ensure that visitors do not go up outside of visiting hours. The building was made with a central, left and right wing on every floor. All floors have clinical wards with some floors having laboratory services, operation theatre and labor rooms. The wards are equipped with a meeting room or a mini library at the center and located on the left wing of the first floor is the management’s office, IT department and Medical Record office. The outpatient clinics are on the right wing of the first floor.

4.2.1 The Outpatient Process

The daily operation of the Alpha Hospital basically involves the process of patient admissions and outpatient clinics. The outpatient clinic is on an appointment basis where referred patients from other medical centres register themselves as a patient in the Alpha Hospital with their demographic data taken by the clerical staff via the registration counter using the patient registration system. The patient is then provided with the appropriate appointment to see a specialist. This could take from 1 week to 6 months. It is only after the appointment is made with a referred specialist that the patient is assessed in order to ascertain if they are to become an inpatient of the Alpha Hospital or not. If the assessment determines that the patient is not to be admitted to Alpha Hospital, the patient
would either be treated during that appointment by prescription medicine or a follow up treatment on another day.

A typical government civil servant who seeks treatment usually comes in with a guarantee letter from the relevant ministry that they are attached to, which states that the patient is either working for the government, (commonly referred to as a government servant in Malaysia) or is the spouse, dependent or parent of a government servant. This guarantee letter exempts the patient from paying the hospital bills and acts as a hospital deposit. Government servants are entitled to free or heavily subsidized hospital care and privileged to different classes of services according to their ranks (Chee & Barraclough 2007).

The general public without guarantee letter are considered to be full paying patients who could also seek free or heavily subsidized inpatient and outpatient care or choose to pay more for higher class wards (Chee & Barraclough 2007; MOH-Malaysia 2010). The guarantee letter is usually obtained via a separate application developed by the Public Service Department and is not integrated with HIS.

4.2.2 The Inpatient Process

Inpatient admission and registration involves bed allocation and recording of demographic data. The generic process of a non-complicated inpatient admitted to the Alpha Hospital as described in a personal HIS documentation owned by the IT department is depicted in Figure 9:
Patients requiring inpatient care in the Alpha Hospital need to be registered via the Patient Registration System which is linked to the Billing System and Electronic Medical Record (EMR). The inpatient admission process as depicted in Figure 10. Once registered the patient can be admitted to an inpatient facility and allocated a bed. During their stay, the patient may be moved or transferred from one room to another or one ward or unit to another. At the end of the stay the admission is terminated and the patient is discharged.
An inpatient is given a standard classification according to the type of service provided and a unique identifier known as the Medical Record Number (MRN) to enable the accounting of all services and products provided during treatment as well as providing a secure unique patient identification for medical procedures. The registration process is again done via the counter in the lobby of the hospital by an administrative clerk through one of the HIS registration and billing modules. The information is then made accessible to the ward expecting to receive the patient. The clerical nurses at specific wards are allowed to access the EMR and check for patient details. However, bed allocation is done manually by the ward nurses and clerks. Depending on the ward’s availability the patient or patient care taker may choose to be assigned to different classes of wards either through the assigned class ranking from the guarantee letter or by choosing to pay a higher amount for a higher class. A typical third class ward in the Alpha Hospital consists of four to eight beds in an area, whereas class two wards are a two bedded sharing room and first class is a single room. Once the patient is safely assigned to the respective ward
the investigation and diagnosis begins. The process of patient investigation and diagnosis is depicted in Figure 11.
During patient investigation, tasks or procedures are performed and goods such as drugs or prostheses are provided. For financial accounting and statistical calculation, all these encounters, tasks, procedures and events need to be named and listed using standard nomenclature usually using codes. A team of doctors, nurses and non-clinical staff are responsible for overall planning of care for the patient. A specialist doctor leads the team and is said to be the doctor-in-charge or attending physician of the patient. The attending physician has the prerogative of inviting other clinicians or other categories of caregivers to be involved in the care of the patient by requesting for their services or referring the patient to them in request for their consultation. The procedures involved in the investigation are fairly standard for all clinical units and cover a range of processes including:

1. Clinical data gathering: Interviewing and examining the patient
2. Carry out further investigations
3. Making diagnosis: Identifying problems and needs
4. Planning for treatment or surgery
5. Carrying out treatment or surgery
6. Review of progress of disease or performing post-operative care
7. Monitoring of effects of treatment
8. Review of diagnosis
9. Review of treatment including determination of outcome
10. Final disposal of the case

As depicted in Figures 12, 13 and 14, the information gathered throughout the investigation is crucial and is stored for real time accessibility of data and future references. The data gathered and stored are the records of clinical processes performed during the care of the patient, the results of these processes and any other occurrences or activities involving the patient.
Figure 12  Treatment Process – Phase 1

Figure 13  Treatment Process – Phase 2: Pharmacy, Operation & Procedure and Referral
Once a patient is assessed as being fit to return home the discharge process begins as illustrated in Figure 15.

Figure 14  Treatment Process – Phase 3: Referral to other departments

Figure 15  Inpatient Discharge
The patient data in digital format are sent to the electronic medical record and billing application to calculate the services and procedures involved during the stay. The charts or scribbling done manually will be hand delivered to the Medical Record Office to be physically stored inside large filing cabinets in the medical record office’s storage room. Inpatients that are discharged from wards are also given a prescription for supply of medication for a fixed duration. The doctor in charge in the ward places the order in the EMR and prints the prescription for the patient. The patient may obtain the drug from the dispensary counter or the drugs may be delivered to the patient.

4.3 The Hospital: As a Site for HIS Assimilation

The Alpha Hospital was designed and developed to implement the HIS as its IS/IT backbone. With the aim of trying to be an exemplar project to the world, a basic hospital information system was inadequate. Hence, a group of medical personnel, consisting of specialists, medical officers and nurses, collaborated with a team of vendors to design the hospital wide information systems that cover an end-to-end computerization of the hospital. The project team started designing the system even before the hospital’s foundation was constructed. Many visits to hospitals of different developed countries were made with the intention of obtaining more information on the best way of designing an HIS. After years of discussion, debate and testing, the framework for the ambitious HIS was created and was called Total Hospital Information System (THIS). The THIS covers all major levels of hospital processes from the very start of patient registration to patient discharge, and includes billing, ward management, patient management, radiology, pathology, pharmacy and administrative modules. The characteristics of the THIS are similar to the definition of HIS in this research as being a fully integrated computer system for both clinical and administrative functions as well as providing means of communication to the relevant departments of the government ministries. Hence, the THIS will be referred as HIS in the next few sections. Figure 16 illustrates the generic Alpha Hospital’s HIS implementation framework.
The HIS for Alpha Hospital is divided into three major modules consisting of the radiology, clinical and administration. The radiology department communicates with the clinical applications using a radiological information system to provide radiography images and results to the ordering physician. To date, the Alpha Hospital has only...
managed to fully utilize and implement some of the clinical applications and radiology due to various barriers and financial constraints which will be described further in the next sections involving themes and findings. The backbone of the clinical module consists of the Electronic Medical Record (EMR), process scheduling, order management, administration and power chart. The scheduling application is used by the clerks and nurses to schedule appointments for registered outpatients. The order management application is used mainly by doctors to place orders on procedures, tasks and tests. The administration application in the clinical module involves the inpatient admission and bed allocation. Power Chart is the main application used by doctors to chart patient’s progress and commonly used as a tool for diagnosis.

The initial plan for the pharmacy was to have a pharmacy interface and information system integrated with the main clinical module; however the promised application was not delivered. Due to issues which will be discussed further in sections 4.5 and 4.6, the Pharmacy Information System interface and most of the administration applications were not implemented or no longer in use. Hence, prescriptions are ordered by doctors through the Order Management application and printed out to be manually delivered to the Pharmacy department. Within the Pharmacy department all processes are still manual with human intervention where a ticketing system is used for preparing drugs or other medication. In contrast, the laboratory is very much computerized and all orders are taken through the order management application which prepares bar codes once the laboratory samples are received. Tests are done according to the bar code labels attached on samples and results are submitted via the laboratory information system which is interfaced with the clinical module.

The Electrocardiograph (ECG) and critical care applications were used during the first year of implementation by the critical and intensive care units (CCU/ICU), however due to hardware constraints which made the system incapable of handling large volume data and restrictions on budget on hardware upgrades, the applications are no longer in use. The Alpha Hospital once had a tele-medicine application interfaced with the Tele-medicine system developed at the Malaysian Ministry of Health. The applications and infrastructure for the telemedicine system were tested and ready for use within the hand
and micro-surgery department, however due to budget constraints, the project has been halted by the ministry until further notice.

The administration and finance module was initially planned to have administration applications such as procurement, billing, human resources and materials management support system integrated with the clinical module and hospital support services interface. However, out of the four applications initially planned for integration, only the billing system under the administration module was successfully deployed and currently being used. The human resource application and procurement application were functional, however, due to the government’s directive that all government organisations must use the standard procurement and human resource application developed by the respective government ministry, the Alpha Hospital’s internal human resource and procurement module are no longer in use. This application was unable to be integrated with the HIS due to incompatibility of technical specifications and complexity of integration.

### 4.4 The Alpha Hospital’s Units of Analysis

This study has identified 5 categories of units of analysis within the case study. The identified categories are the champion, medical doctors, management, administration and IT department. Table 9 describes the codes assigned to the units of analysis that will be used throughout this research, the category that they belong to, and the number of times the interview was conducted with each of the interviewee.

<table>
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<th>Number of times interviewed</th>
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4.4.1 The Champion’s Perspective

Actions or behaviours by the members of the organisation can directly or indirectly influence organisational effectiveness (Barney & Griffin 1992). It must also be acknowledged that these actions and behaviours may also be influenced by other co-workers, namely those who exert more power, such as the champion. It can be argued that in a public hospital context, the person who has more power is able to have control over the assimilation of the information system. It is quite common in a government organisation, such as the public hospital, to have a person of higher rank in control and exerting power over others in order to have staff compliance to his/her directions. In this context, it can be argued that the champion, who is a chief surgeon and the IT coordinator, is an integral player in the success of the HIS assimilation. The champion is known as Mr. C and he has been pioneering the HIS project from a time before the hospital’s foundation was constructed.

Mr. C is a very intriguing character. One would see him as a mature, serious, bold, and strict yet charismatic figure who detests any inaccuracies and misdemeanours. He is one of the few people in the hospital who gets greeted and smiled with a nod every time he walks around the hospital. He is one champion who could make other staff especially younger ones stop talking to each other and get back to work with haste once they spotted him walking towards their area. This portrays the exertion of power is indeed very
obvious when a person is saluted as an esteemed surgeon with a high level of healthcare information systems knowledge.

Mr.C’s daily activities involve looking after patients in the ward, caring for outpatients and performing operations. However, Mr.C spends a massive amount of time in the IT department examining how the information systems and applications are able to assist his fellow clinicians. He feels that it is his responsibility to handle the hospital’s business process reengineering (BPR) as he is the one who writes requirements, request for proposal, and provide input for the database and project management. In terms of information systems adoption, Mr. C does not see an issue arising in the Alpha Hospital as the hospital starts off with computerization and everybody has to use the system. His opinion on the adoption of HIS is:

“In terms of adoption it's 100% adopted, everybody uses computer and the computer is everywhere....... As far as I'm concern typing is not an issue here, so, adoption is not a problem...”

[Mr.C, Clinical & IT]

In going paperless, he admits that whatever can’t be done through the system is still conducted manually on paper, as the system is incapable of providing medical staff with certain features namely with respect to data integration. This was due to the technical difficulties and when asked about the technical performance of the HIS, Mr.C responded as:

“We have technical problem since the beginning, because at the point where we bought our equipment it was low end, when we upgraded it, it improved a little, otherwise the response time was not very good”.

[Mr.C, Clinical & IT]

There are a few reasons that Mr.C sees as the cause of these issues - some of them involve the incompetence of the vendors doing maintenance and support. There are also testing issues, government policies and funding. On the subject of vendors doing maintenance Mr.C’s states -
“I’m putting in a new product, that needs to be interfaced with the existing IS, and the kind of support that we get from the supplier is very poor and the expertise of the system integrator is also very poor. Each time when new vendors take over there’s a dip in the response time and system down, even the current one we ask for 99.9% uptime, they cannot provide us with that because they say our system is old.”

“We request them to provide a report at the end of the month, but still we have to draw out the requirement spec for the report for them, where is the data, which data element do we want, what are the rules. If you don't do that they don't know and it is very difficult for them to understand...”

[Mr. C, Clinical & IT]

Other general concerns discussed were the staff turnover policy of a government hospital, Mr. C’s role as an IT coordinator, and the dilemma of obtaining support and understanding by the government with regards to financial issues.

Mr. C feels that the turnover rate of a civil servant being transferred to other government departments or agencies is not suitable for a hospital with HIS. Staff would take things for granted and could not care less about the actual use of the HIS as they know that they could be transferred to another hospital without an HIS at any time. His views on this matter are:

“.....the government does not have a policy of trying to retain people in the same place, even the IT programmers; they will be transferred to other departments based on promotion.”

“People come here from other hospitals, the problem is we have very high turnover rate, like all other government hospitals, very high turn over rate, people come they stay about a year or 3 years at most, only the old clinicians will stay for a long time, but the rest they just stay for training and they go for their training elsewhere. So, they stay a short while...”

[Mr. C, Clinical & IT]

Since the Alpha Hospital is a government owned public hospital, policies on human resources amongst government ministries and agencies also apply to the hospital. There are currently no policies to retain people in their current positions and chances of staff
being relocated due to job promotion are not uncommon amongst the government staff. Mr. C also admits that the policies made by the Malaysian Ministry of Health are not very clear and somehow limit the use of the HIS.

“Again policies are pretty standard throughout; we have to actually adhere to the policies of the Ministry of Health. That provides some difficulties and limits our use of the system.”

[Mr. C, Clinical & IT]

When asked about his opinion on the overall assimilation of IS/IT in the Malaysian healthcare industry, Mr. C responded:

“Slow and in many ways a failure, because we are not working and using whatever we have learned, we are not correcting the things that were done wrong, we did not learn from one hospital to another.....”

[Mr. C, Clinical & IT]

Nevertheless, as a champion he is determined to make improvisations, so things will be successful by constantly suggesting continuous improvement ideas to the Malaysian Ministry of Health, even though his ideas are constantly rejected because of cost limitations and/or misunderstanding by the Malaysian Ministry of Health of the practicality of his ideas. He is a very determined champion and as he claims in the interview:

“I'm a patriot, I am staying here at the government service, I'm a shameless patriot....... I know that the journey is long, I don't mind waiting, I have tried working with and for the ministry but lately they don't seem to be very happy with me working there, so I come back to do the ground work, testing scripts, these are the work that I am not supposed to do, but nobody else can do it, so the business process re-engineering, workflows, all of these are drawn by myself, because nobody else would want to do this..”

[Mr. C, Clinical & IT]

In spite of problems Mr. C. has encountered regarding the assimilation of HIS, he still feels that the Alpha Hospital is a success story. To overcome the issues, he believes it would require major changes to the business processes and operations of public hospitals in Malaysia. In providing greater success, he is willing to provide continuous effort in the
IS/IT process improvement and wait for greater success that he anticipates will be realized in future.

4.4.2 Management Perspective

The top management team of the Alpha Hospital is headed by the Hospital Director assisted by the Deputy Director of Medical and Management. Each of the 19 clinical departments and the rest of the non-clinical departments including IT have a Head of Department, who reports directly to the Deputy Director of Medical and Management. Strategic planning and decisions are made based on the directions from the Medical Director General at the Malaysian Ministry of Health with the involvement of the top hospital management. The Hospital Director, who was the leader of the pioneering team in setting up the Alpha Hospital with the HIS project, was recently promoted and relocated to the office of the State Health Director. The new Hospital Director is from a manual hospital in a different state in Malaysia and works hand-in-hand with the Deputy Director in resolving HIS issues at the hospital. The Deputy Director (MD1) was involved with the pioneering team of the HIS project. The interview with MD1 was very informative and detailed since the overall management and ministry’s perspective was discussed. MD1 is responsible for all daily clinical and non-clinical matters of the hospital including IS/IT issues. When asked about the assimilation stage of the HIS at Alpha Hospital, MD1 feels that:

“I think we have reached a mature stage because this hospital started with a system since 1999 so we have reached a stage of routinization...”

[MD1, Management]

However, in terms of system performance, MD1 feels that due to the delay in upgrading the HIS, the system is not up to its optimum performance.

“Due to some delay in the process of upgrading, So that has caused some lack and problem. If you are talking about performance, we are not at the peak of our performance, this is because of system obsolescence and hardware.... but we are right now in the process of upgrading. So, we are having a lot of problems right now, in terms of performance because the system is almost 10 years old.”

[MD1, Management]
This opinion somehow conflicts with the perception of MD2, one of the clinical Head of Department, MD2 feels that:

“As far as this department is concerned, we are very happy. It makes our work faster, makes our work easier... you don’t have any hiccups here and there... So, they are really happy with it.”

[MD2, Management]

Nevertheless, MD2 is providing an opinion solely based on the use of HIS in his department whereas MD1 sees the system as applied to the entire hospital. To support the claim of Mr.C with regards to having government policies and documents, MD1 also feels that compliance to some of the government controlled documents limits their utilization of HIS. MD1’s comments were -

“An external issue for HIS is when you have documents which are government controlled. For example the permits and medical certificates (MCs), where computer generated may not be accepted, so you still have to go back to paper. For example, blood transfusion, by law you need to have that 3 or 4 coloured papers where this one goes here that one goes there, so you still have to maintain that. Then you have to update in the system, so all these are double work, but these are external factors that cannot be helped, as there are a lot of government controlled documents.”

[MD1, Management]

When asked about the rate of HIS assimilation in public hospitals in Malaysia, MD1 disagrees that the rate is slow. MD1 states that the decision to implement HIS or not to implement HIS in other hospitals throughout Malaysia will depend on the services provided by the targeted hospital and the cost effectiveness of having the technology assimilated in the chosen hospital. MD1’s view on this matter is as described below:
“It's not the slowness, but it depends on the service, the hospital involved and the budget. For example PACS, it's very expensive, so it was not cost effective to put in smaller hospitals that are necessary have a CT scan maybe they just have X-ray... you would have to see the services offered by the hospital, the budget availability, so we made it such a way that it should meet the level of service of the hospital... so the systems are embedded slowly according to the needs.”

[MD1, Management]

The decision to implement HIS is also made in accordance with the government’s 5 year strategic plan. Every 5 years there will be a new budget presentation by the Prime Minister of Malaysia, and depending on the healthcare allocation, HIS will be allocated a proportion of the budget funds derived after considering other healthcare expenditures, such as the operational costs, maintenance and new hospitals. This is clearly stated by MD1’s explanation of this process:

“... we do it in a 5 year planning, maybe for the Malaysia’s 7th development plan, we decided on Hospital A and then Hospital B, the next 8th Malaysia Plan will be another hospital, and then the 9th Malaysia Plan, so that depends on the budget availability. So maybe in the 10th Malaysia Plan we’ll continue with other state hospitals, we do it slowly...”

[MD1, Management]

MD1 mentioned that assimilating HIS to other hospitals should be done slowly because the way HIS was introduced to Alpha Hospital, through a “big bang” method, was found to cause some of the problems that they are currently facing. For this reason, MD1 feels that a modular approach which involves introduction of clinical applications in a smaller scale across different clinical departments will be more suitable for the newer hospitals. Nonetheless, the principle of assimilating the HIS in a modular manner does not indicate that the rate of the assimilation should be too slow so as to fall behind the latest healthcare technology advancements and compromise staff enthusiasm. As MD1 claims:

“... in a running hospital you cannot do a big bang you'll get a culture shock. But in terms of being slow you must not also be too slow, maybe after the certain modules are up and
running, 3 months after, we should move to another application, while the enthusiasm is still there we start a new one…”

[MD1, Management]

When asked whether or not the HIS in the current hospital is a success, MD1 Responded:

“...whether or not it is successful you would have to do a thorough audit both qualitative and quantitative, qualitative audit has been done before, it is found to be useful but quantitative is very difficult, for example if someone were to see the ROI it's very difficult to measure because most of it is qualitative, so in that sense we do not have any quantitative measures, it is very difficult...when people who are the policy makers they make decision based on quantitative measures, they base on numbers, so it's very difficult to convince someone that "Look, HIS actually works"...and we still do not have data that shows HIS actually helps with patient's safety. You can only do that when you know how many errors you've made and how many errors you have not made with or without HIS. There's no data. So it's very difficult. But those who have used it you can ask them, they will never go back to manual. So, in that sense it works.”

[MD1, Management]

In summary, the interviews have shown that management feels that when assimilating HIS, the key is to know what the clinicians and other users want and not to be influenced by suggestions and proposals from the IS/IT vendors. Most importantly, clinicians need to have the knowledge to utilize IS/IT technology in producing data that would assist them in making decisions, predictions and producing high quality research. From the perspective of the hospital management, the existence of champions such as Mr.C and the nurses who are competent in IS/IT (clinical IT nurses) has provided a significant impact towards the success of assimilating HIS in the Alpha Hospital.

### 4.4.3 Clinical Perspective

The clinical personnel at the Alpha Hospital are a resourceful, valuable and dedicated group of people in their jobs. Although they pledge the same vow to save people’s lives regardless of background, race or religion, these people do have a widely diversified opinion with regards to the HIS. Even the most senior clinicians, who were members of the initial HIS project team that set up the Alpha Hospital, do have differences in how
they perceive the success of assimilating HIS into the hospital. When many of the senior clinicians compared the use of HIS to manual hospital processes, they felt that the HIS provides greater benefits since the retrieval of records and test results can be done very quickly. For some of the senior clinicians who would like to see change taking place in a typical manual hospital, the existence of HIS has definitely helped them in many ways, especially in reducing their workload. Some of the positive comments when asked about their perception of HIS were:

“...everything that is documented is properly placed, as you know we doctors’ handwriting are not easily read, so it’s helpful ...... when you retrieve the data, it is also easily retrievable, especially the lab results, it can be retrieved almost instantaneously...”

[SD1, Clinical]

“...it's always nice to venture into something different, and it sounds something for the better, in the good old days we always have problems with lost medical records and all that, difficult to trace , not enough people to trace, a lot of problems.....it's something very interesting and challenging...”

[SD13, Clinical]

“..it does help in terms of data, waiting for result, that is better...”

[SD3, Clinical]

Some clinicians feel that the HIS is a big disappointment as it did not deliver what was promised. The existence of HIS is literally there for the sake of having a system which supposedly realizes the paperless vision in place. However, it seems the HIS is without any other value added features that could assist the clinicians’ daily activities. There was frustration and discontent when this matter was being discussed in the interview as the clinicians had their expectation that HIS was supposed to assist them to perform their duties more efficiently.

“...the system should deliver what it promised.....when we can’t access it, that's really frustrating and a waste of time...”

[SD2, Clinical]

“...the objective was to have a total HIS, but it's not, so that's a problem....”

[SD13, Clinical]
“...the project comes about because our information and data gathering was poor, our records was poor. The main aim of the project was to rectify that, but it didn’t happen, not even half, I would say 25% achieved...”

[SD17, Clinical]

Most clinicians commented that the greatest feature of HIS is that data is stored and can be retrieved faster that a normal manual patient file. However, SD17, who was also one of the members of the Alpha Hospital HIS initial project team, strongly feels that the retrieval is actually a failure. What was retrieved is exactly how they have entered it and how you would see it if it were on a hospital physical form. This indicates that no data processing was done and the system was not able to produce specific reports on the patient should they require a specific query on the department’s patient such as average age, specific type of disease based on gender, number of times admitted in hospital and medication prescribed.

“The worst part is that we wanted to achieve retrieval of information which didn't happen. That is the greatest failure...”

[SD17, Clinical]

Many clinicians who require statistical analysis of patient’s data see this as a major frustration. The clinician’s work practices are highly dependent on the information systems. Thus, knowing that millions of dollars were spent on the entire HIS during the initiation and adoption stages, the expectation that the system is able to produce at least basic statistics is certainly unfounded thus produces sheer frustration.

“With IT, statistics should be like a breeze isn't it?..... by right all this information is put in the system isn't it?So, can’t I get simple things like how many Malays, Indian, Chinese, under 18 , above 25, but it's not there..”

[SD3, Clinical]

“I feel that if it was just pulling out the list of patients I feel that it is something that my clerk should be able to do? This only involves registration information, so who comes and who failed to show up, should have been showed easily, so what happens now she has to do it manually. ...our patients are so crucial, we need the previous record to study the trend and formulate because they could be okay in one day and off the next. If
something happens to one of my patient, I need to see what happened to them previously? what's the pattern? But I can't do it.....”

[SD2, Clinical]

Notwithstanding all of these frustrations regarding the capabilities of the HIS, the clinicians do admit that the system is crucial to their daily activities. When the clinicians were asked if they would revert back to the manual system, the answer is an emphatic “No”. There has to be major improvements to the entire system in order to meet the current expectations of the clinicians and, if possible, anticipate the future needs of the clinicians staffing an end-to-end IS/IT equipped hospital.

4.4.4 Non-clinical Perspective

There are generally three categories of non-clinical personnel under the supervision of the Deputy Director of Management. These categories are general administration, finance and human resources. There are other non-clinical personnel who are placed under clinical administration, as they are involved in providing ancillary services, such as food preparation, patient’s welfare, patient education, public health, ward administration and medical record processing.

The initial objective of having the HIS at the Alpha Hospital was to have a fully integrated end-to-end hospital wide system for both clinical and non-clinical staff requirements. The non-clinical system was initially planned to have a human resource module, materials management, and hospital support services interface. Due to issues such as complying with the direction by the Malaysian Ministry of Health to use the Ministry’s human resource and procurement system, the developed module for the HIS is no longer made available. The current intensively used non-clinical modules integrated with the HIS are finance application and the registration system.

Since the only non-clinical staff who have had experience with the non-clinical HIS are the finance and billing staff, there is a very unbalanced environment for the general administrative staff who are positioned at the clinics and wards. They are there to check the scheduling application done by the clinicians and are not given any access to the HIS clinical modules.
Part of the justification by the management and IT department as to why the security of the clinical HIS was very rigid towards the non-clinical staff was due to fear of misuse of information or breach of patient’s privacy. Since the design of the clinical module was made quite “open” to any clinical department that is treating the same patient, the history and diagnosis of the patient can be made public to anyone with the right access. During the interviews, some clinicians explained that there was a local celebrity admitted at the Alpha Hospital and the information on the patient’s diagnosis and test results were given to newspaper journalists by an unethical staff member, who managed to obtain the information. The staff member responsible was traced by the log in record and was given a strict warning.

As the decision made to secure the patient’s data seemed justified by the management, it seems a somewhat inflexible process for those staff who require frequent access to the clinical module in the course of performing their duties. Whilst working in the wards, non-clinical staff are able to seek authorisation from ward nurses or house officers to use their logins for work related enquiries. This practice, however, compromises the audit trail information and accuracy for security management. The non-clinical staff also feel that there should be enough facilities for them to carry out their current manual processes:

“With the manual work that I do right now, I think if there was a system it would help a lot. But we still have a problem of not having enough PC here in the ward, it’s impossible for each of us to have a PC here...it’s common here to take turns to use the computer.”

[NC3, Non-clinical]

The finance and billing department staff members have a different view on the HIS capability and functionality. The HIS does assist them in many ways, especially when many of them were from hospitals with manual billing processes. When asked about any issues pertaining to the HIS, most of their concerns were not from the HIS, but the policies that they had to adhere to as a result of working in a government hospital. In a public hospital, patients come from many different backgrounds, and, sadly for Malaysia most have financial challenges. Hence, it is a problem when some flexibility with HIS processes is not possible if a patient is unable to pay the hospital bills. As compared to the manual processes, cases such as missing bills or “hanging” bills without settlement
are quite common. The billing team in the Alpha Hospital is responsible for justifying cases where the reports of unsettled payments are produced at the end of each month. The billing team feels that they are sometimes placed in a very difficult position, especially when dealing with trauma cases, where the doctors have an obligation of treating patients regardless of financial status. The billing team is not in the position to refuse these patients’ medical treatment and to avoid any embarrassment and discrimination for financially compromised patients. Most patients are registered into the system and allowed to be admitted based on an acceptable guarantee letter or some form of financial deposit.

One of the billing team members, NC2, shared her most unforgettable experience dealing with unpaid hospital bills of up to $2000 by a foreign student who forged entry into the Alpha Hospital using an invalid passport and a bank statement as a financial guarantee. Upon completion of treatment, the patient absconded without formal discharge.

NC2 feels that this incident can cause a major issue in future for the entire Malaysian healthcare industry as the current loopholes of the public healthcare policy and hospital processes has been discovered by a minority group of unethical people. The billing team had to make a report on the incident and since the authorities were unable to track the patient, eventually the Hospital Director had to sign a consent form indicating payment of the hospital bills shall be covered by government funding which comes inevitably from the tax payer money. NC2 hopes that the HIS would be upgraded to incorporate linkages to the police database or immigration department of Malaysia to check on patient’s background and validity of the patient’s identification documents.

4.4.5 **IT Department Perspective**

The main responsibility of the IT department of the Alpha Hospital is to supervise and oversee the technical support provided by the appointed local vendor to the users of both the clinical and non-clinical departments. The IT department staff are involved in gathering requirements from the users, evaluating change requests and assigning the requests to either the vendor or to The Alpha Hospital’s IT nurse application specialists. User training is done by the Alpha Hospital’s IT nurses on weekly basis for new clinical staff and existing staff who require further training.
The department consists of a Head of Department who works closely with the IT Coordinator to oversee the projects and attend high level meetings. They are supported by two deputy heads for the clinical/non-clinical unit and technical services, IT executives providing second level technical support to HIS users, Head of IT nurses, nurses conducting HIS user training and administrative officers. The first level helpdesk unit consists of staff members from the local IT vendor. The technical support first point of contact is the helpdesk unit which is outsourced to the maintenance IT vendor. The helpdesk team records details of user problems, evaluates the problem and, if required, engages further technical consultation. The support call will in this case, be escalated to the second level support and if unresolved, escalated to the third level support which is the international vendor technical support.

On the surface, one may perceive that the purpose of the people in the IT department is quite questionable since almost all of the maintenance work has been outsourced to the vendors. However, the IT department’s service with the existence of the champion and nurses of clinical background is also required in providing technical and clinical input for upcoming projects, approving budgets, handling of reports or project documentations, developing the IT plan and strategies and evaluating new or relevant emerging new IS/IT. When asked what they think about the HIS at the Alpha Hospital, IT5 and IT1 responded:

“...in terms of usage I see that it helps but in terms of technicality, because we are in IT, I think it can be better ......in realizing the dream of being the first hospital to have HIS, in terms of that it was successfully realized of course, but in the long run it becomes more difficult”

[IT5, IT Department]

Some of the difficulties discussed were the lack of funding in purchasing new hardware, unused modules due to directions from the government and incompetency of vendors to support the systems.
“...in the beginning all of these were integrated but then because of some reasons such as the government's direction to use their e-procurement and HERMIS (HR module) so those applications take over the modules that are supposed to be in the HIS. So, right now to do purchasing, we have to use the E-procurement by the government”

[IT5, IT Department]

After 11 years of assimilating the HIS into Alpha Hospital the staff of the IT department do feel that there should have been some form of study done on the pilot project to see the success and failure of the Alpha Hospital before embarking into newer hospital projects and repeating the same mistakes. This indirectly indicates that the IT department could see many flaws and mistakes done by the initial project which causes many unresolved technical issues that requires major change and improvements with a large amount of budget.

“... we already have this hospital, so firstly I think we should study from the previous implementation. What I can see is that the mistakes done in Malaysia's hospital implementation is that the current implementation on other hospitals do not study this hospital first, this hospital was the first, so they should have studied a lot, but what happened is that they don't study, they don't even have a team to come down to do the ground work to study and talk to us on what are the problems. So they do as they like, so what happen is the same mistake repeating in other hospitals..”

[IT5, IT Department]

“...the body that is responsible for the implementation of new hospitals should have studied first before implementing, what are the problems....once they've identified the problems look for solutions that can cater for all the problems”

[IT1, IT Department]

“...we really had a bad time during 2004 to 2006 where at that moment both our hardware are failing. So, we had to survive based on firefighting action. In terms of repairing, the cost is really high, so when we finally manage to obtain a new server we managed to sustain after that. But the cycle continues right now, because there are servers that are no longer supported, and there's the software that we are using such as the CERNER version which is no longer supported.”

[IT2, IT Department]
Associated with this issue, the IT department staff also feels that support from the management team is crucial in order to ensure successful assimilation of the HIS. Due to differences in technical understanding between the IT department staff and clinicians, it is also crucial to sustain the champion and IT nurses positions in providing a means for a cohesive approach and working relationship involving all parties. Therefore, from the perspective of the IT department staff, whether IT support is done internally by themselves or outsourced, it is important to have a team, which may include management staff, to assess the efficiency and effectiveness of the IS/IT technical services. Furthermore, this would also lead to continuous effort on reviewing the status of the current hardware and software.

4.5 Themes and Sub-Themes for HIS Assimilation

Various issues pertaining to the assimilation of the HIS were discussed based on the themes identified from the conceptual framework, as well as emerging themes identified through the interviews. Table 10 and Figure 17 illustrate the themes identified with the percentage of the number of times participants directly or indirectly mentioned the issue(s) during their interviews.

From the frequency table (Table 10) and Figure 17 below, it is noted that the most frequently discussed issues among the identified themes were clinical IS/IT experts, HIS system design, HIS performance, core business processes, culture and integration. The following sub sections will elaborate on the issues discussed during the interviews.

<table>
<thead>
<tr>
<th>Theme</th>
<th>Sub-theme</th>
<th>Percentage number of times the issue being mentioned by respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>People</td>
<td>Clinical IS/IT Experts</td>
<td>75%</td>
</tr>
<tr>
<td></td>
<td>Medical Staff</td>
<td>50%</td>
</tr>
<tr>
<td></td>
<td>Vendor</td>
<td>40%</td>
</tr>
<tr>
<td>Process</td>
<td>IT governance</td>
<td>50%</td>
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<tr>
<td></td>
<td>Clinical governance</td>
<td>50%</td>
</tr>
<tr>
<td></td>
<td>Financial</td>
<td>45%</td>
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<tr>
<td></td>
<td>Procurement</td>
<td>25%</td>
</tr>
<tr>
<td>Technology</td>
<td>Healthcare IS/IT Infrastructure</td>
<td>35%</td>
</tr>
<tr>
<td></td>
<td>Software/ Hardware</td>
<td>55%</td>
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<tr>
<td></td>
<td>System Design</td>
<td>45%</td>
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<td></td>
<td>Performance</td>
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<td></td>
<td>Integration</td>
<td>50%</td>
</tr>
<tr>
<td>Environment</td>
<td>Political</td>
<td>40%</td>
</tr>
</tbody>
</table>
4.5.1 People: Clinical IS/IT Experts

In order to successfully assimilate HIS at every stage, there is a need to have more people in the organisation possessing both clinical and IS/IT skills. However, the current lack of clinical and IS/IT skilled people are not only an issue within the Alpha Hospital, it is also an issue at the Malaysian Ministry of Health. The following are comments made by senior clinicians and the champion on the issue of dual skilled scarcity among healthcare personnel during their interviews.
“...actually we should have more people who knows both sides, the work itself the operation and a bit of IT, and a lot about information management, data management, the problem is we are not developing these people.”

[Mr. C, Clinical & IT]

“Without people like me these people will not understand, and also they dare not venture out, like me I can venture out to the ward, to the clinics, x-ray department without being obtrusive, even now I'm trying to get the programmers and analysts out there, they are used to sit in here and just do their work.....people in the ministry they are not even sure what is it that we want out of this IT, even though I've been telling them about this data extraction and all, you want a report generated at the end of the year or something, the hard work is here, understanding the database, but people who wants to do that job is not here”

[Mr. C, Clinical & IT]

“...technology is there, but people are not there..”

[SD13, Clinical]

“In Malaysia everything is about project, then it is left to the development people whereas the operations people who should be more involved. The operations people will say this is how we do work and tell the development people please buy us this kind of system, well they are just about doing it that way right now, but they don't bring in the right people”

[Mr. C, Clinical & IT]

In order to have clinical and IS/IT skilled people, there is a need for training and exposure to both areas and for people to remain in the environment in order to increase their understanding through hands on experience. Considering the Alpha Hospital is a public hospital that complies with the Malaysian government’s human resource management policy, the possibility of people being transferred to other hospitals or other government healthcare agencies is certain, especially due to promotion. Therefore, it is difficult to retain a person in one position and train them to acquire the necessary skills on both clinical and IS/IT. Considering that staff may be transferred elsewhere, the attitude of taking IS/IT skills for granted can be seen in some clinicians as the skills acquired in a
hospital with HIS may not be useful at all once they are transferred to a non HIS equipped hospital. These are some of the problems commented on during the interviews on staff turnover.

“…the people who come in here the dynamics is very fast, so you train them then they go away, then you have to retrain so skill is lost along the way and people develop their own skill.”

[SD17, Clinical]

“I think in terms of IT staff also, well the Head changes so many times, so people come and go, so the continuity is not there, if this is to be our backbone then that department has to be very strong.”

[SD13, Clinical]

The Alpha Hospital still has a long way to go in encouraging the clinical staff to be skilled in IS/IT. The support from the IT department is crucial especially in the adoption stage. In addition to ensuring that the technical support is well delivered, it is important that the people in the IT department have the attributes of strong technical competency and excellent customer service skills. These attributes, as discussed by Wager, Lee & Glaser (2005), ensure the staff are able to execute their tasks well and demonstrate a sound understanding of the organisation’s needs, an ability to be good consultants and provide world-class support, and an undertaking to keep up to date with new techniques and technology that may improve the organisation’s IS/IT effectiveness. There is, however, a lack of soft skills and commitment to service amongst the vendor technical support team of the Alpha Hospital. This team consists mainly of outsourced local vendors who have minimal experience in IS/IT troubleshooting and virtually no clinical knowledge. These are some of the complaints made by clinicians as users of HIS:

_The most important thing I feel is that they should be more concerned and attentive to problems. If there is a problem they would have to rectify as soon as possible...at the end of the day it's all about human nature, to be more professional in their conduct...”_

[SD1, Clinical]
“...and when I complain, then they start saying "yes, we understand your problem but then the system is this and that" so it feels like there is no point complaining because nothing can be done.”

[SD2, Clinical]

Despite a number of clinical IS/IT issues, there is no doubt that the significant success of the HIS is due to the Alpha Hospital’s people who possess both clinical and IS/IT knowledge. Many of the people interviewed admitted that a key factor to the success of HIS was the existence of the champion and the IT nurses; who are seen as playing an important role in bridging the knowledge gap between the clinical staff and the IT staff. This staff structure and functionality is unique to the Alpha Hospital as there has not been any other IT nurses position in other public hospitals, including newer hospitals with HIS.

4.5.2 People: Medical Staff

People (personnel or human resources) are the most valuable asset of an organisation, and the proper management of the human resources has both strategic and legal importance for the organisation to achieve substantial performance (Barney & Griffin 1992). Unfortunately there are significant issues involving medical staff using the HIS at the Alpha Hospital. The comments made during the interviews by clinicians were mostly directed at poor medical record documentation, clinicians attitudes towards the HIS, human resource management of the government appointed healthcare staff and the lack of IS/IT exposure to medical staff.

With regards to poor medical record documentation, the lack of initiative amongst clinical staff to record patient details into the HIS leads to incomplete data, thus compromises future patient enquiries and reports. Medical record documentation contributes to the completeness of patient’s records which are essential for patient’s safety and quality care (Jao, Helgason & Zych 2007). The poor history of medical record documentation by some clinicians in Alpha Hospital is very disturbing as these clinicians do not see the importance of storing relevant details about patients into the HIS. It is not entirely up to the champion or the Head of Department to constantly remind the staff to
make sure that they do proper documentation. It is all part of the clinician’s initiative, understanding and awareness of storing complete patient’s record.

“Documentation is poor here by the doctors, when you place orders you are supposed to document it in the system, it's part of the medical doctors practice, but still people don't document, it's a matter of habit, this one is not so much of the system but the attitude. This is the weakness of our own professionals.”

[Mr. C, Clinical & IT]

“...well our people as always they like short cuts so there's a lot of rubbish in there, quality is not there. Garbage in garbage out...”

[SD17, Clinical]

“...we depend on the notes that are written by our junior doctors, they might not put in the right information. Most of us dictate the notes, they are supposed to type it in, if we were typing it it's fine, but when they type it if they use short forms, we don’t know what it means. We have lots of short forms in the system, and then later when you read it you have no idea what it is all about.”

[SD3, Clinical]

During the interviews with MD1, SD17, SD5 and SD13 who were among the initial team members of the Alpha Hospital’s project, it was mentioned that initially the Director of this project warned those who intend to work in the Alpha Hospital to have a passion for working with new technology and leave the “manual processing” attitude behind before coming into work at the hospital. Nevertheless, employee’s attitude and behaviour is highly dependent on the working conditions, co-workers and leadership within the organisation (Barney & Griffin 1992). These influences create a spectrum of staff attitudes, ranging from a very satisfied and positive person to a very dissatisfied, withdrawn and negative person, and all attitudes in between (Barney & Griffin 1992). With the Alpha Hospital staff, some of the personal negativity is due to a lack of patience, and the perception that the HIS will cause delays in the performance of their duties. Hence, with technical difficulties using the HIS, some clinicians do have the tendency to revert back to manual processing under these circumstances.
“...especially when there is downtime they go immediately on paper and when it goes up again you have to ask them to key in all that in to the system. So they become frustrated...when they are really frustrated it really goes down. And once they are back to paper it's very difficult to get them back.”

[MD1, Management]

“...sometimes I feel it's easier to type than click. To a new person maybe it's good for them to click here and there as a teaching tool......by the time you click, click and click it's actually faster if I write the diagnosis straight away. So, if you have time yes it's nice, especially here time is crucial. I think that is one of the reasons why people are reluctant to change.”

[SD3, Clinical]

“I remember when we first started this project, previous Director General guided us, we all were happy to come here but if you decide to bring your "baggage" with you from elsewhere then please leave, in other words it's trying to tell you that you need to have your mindset changed and be into it.”

[SD13, Clinical]

“...in terms of the system it's a routine, but to the person, well some people are just reluctant to change, some people just don’t want to change.”

[SD3, Clinical]

In order to reduce this inclination towards rejecting the HIS, the clinicians’ buy in process at the HIS project initial stage and awareness of the importance of patient’s record completeness is critical. The Alpha Hospital management realizes that there should be continuity on the commitment given by the clinicians to use the HIS and to maintain their interest in current and developing technologies.

4.5.3 People: Vendor

As with all other Malaysian government ministries, projects are usually undertaken by outsourced vendors who have succeeded in winning the bidding process for the project. Maintaining the HIS of a hospital is considered as a project with a 3 to 5 year contract. The cultural norm for the vendor selection process in Malaysia usually revolves around the vendor’s relationship with influential people; namely, a contact at the Malaysian Ministry of Health, who is authorized to approve government projects. Depending on
whom you know, and who knows you, is more important than demonstrating your competency and capability for handling the project. This creates major issues with the success of the HIS assimilation as the level of competency, knowledge and work attitude of the vendors is questionable.

This is supported by excerpts from the interviews:

“...we do not have a good handover from the people who manage it initially, so they disintegrated, after our project was disintegrated, and we ourselves were not sure of what system administration entails, therefore our contract is also very loose, there was no documentation from one contractor to another, these contractors were given a yearly renewable contract, they themselves are not sure and often they don't do good documentation.... people who are new (the vendor) they don't know what this business is all about, so they just can't maintain this properly, we have regular meetings with them quite often we have to tell them what to do...only a few of them are seniors and most of them are juniors.”

[Mr. C, Clinical & IT]

“...they are contractors that come to do operation & maintenance, they run the call center as well, they are supposed to produce a report, but quite often we are supposed to tell them what to do rather then being professionals that already know what to do, that's why we still have our own people around, we got the system manager, application analyst people who know the backend, and then people like me who knows the clinical aspects, and the people who knows a little bit about network and all."

[Mr. C, Clinical & IT]

“...some vendors, when they get the project, in the contract everything looks very nice, suddenly when implementation, like some of the problems we face here, they say software is not compatible, we need to downgrade PC, those sort of things that we never expected.. they are also a little slow in implementation this time. We expect not to be up to a year, now it’s almost a year already, still with problems.”

[MD2, Management]
“...yes we call the helpdesk, but things tend to get collected....okay your call is logged and they try to solve, and then tomorrow the same thing happens again, and you call them again and then tomorrow again and again and again, the users then get tired...”

[SD2, Clinical]

“...in the beginning I realize that there was very little monitoring by the vendor, they do not know what to lookout for, they lack technical skills. Some staff are not competent, so they can't see, so they can't do well in monitoring, so it's a good thing we have our experienced staff, so we monitor together, so when we detect the problems we have to instruct them on what to do”

[IT5, IT Department]

Generally, the staff of the Alpha Hospital would like a more competent and knowledgeable vendor who does not possess any special interest in the projects being awarded and ultimately provide the best technical support with a guarantee of 99.9 % uptime.

4.5.4 Process: IT Governance

An organisational process can be described as a set of activities with a structure that describes their logic and dependence within an organisation (Aguilar-Savén 2004). Recently there has been an increase in the emphasis of placing efficient business processes within the healthcare environment to improve medical quality (Leu & Huang 2009). In order to have an efficient business process in the healthcare domain there is a need to analyse the as-is situation of the healthcare organisation (Rinderle-Ma et al. 2010) and thereby also provide relevant recommendations on appropriate IT governance structures to be adopted by the healthcare organisation.

In the case of the Alpha Hospital, various IS/IT process issues were described during the interviews with IT department staff and the champion that these processes require immediate and on-going attention from the relevant authorities governing the hospital. The IS/IT process issues discussed were IS/IT human resource management, information management, IS/IT workflow, IT vendor management, IS/IT maintenance, upgrades and testing, and adherence to public service standard processes. The participants’ suggestions
implied that the Alpha Hospital is in need of a proper IT governance structure especially in relation to change management, release management, vendor management and IS/IT financial management.

As organisations continue to grow and change, the IS/IT requirements evolve, thus leads to more new discoveries of errors and problems when applications are not upgraded accordingly to accommodate the organisational growth (Georgiou et al. 2007; Leonard & Mercer 2000). In the case of the Alpha Hospital, the interview participants had mixed opinions on the issue of IT governance, these issues including both technology and organisational processes. Considering the technological aspect, adopting a straightforward well-known IT governance structure such as the IT Infrastructure Library\(^1\) (ITIL) is very difficult as the IT department is dealing with numerous issues in adhering to policies set by the government. In addition, this situation is further complicated because it is necessary to maintain a legacy system which is technologically challenged in ways pertaining to the design and hardware capabilities. Reasons contributing to the IS being technologically challenged were the lack of budget to install better hardware, the lack of technical competencies of the appointed IS/IT maintenance vendors and the lack of knowledge of the decision makers at the Malaysian Ministry of Health. Further, the decision makers and senior Ministry management did not anticipate the major role of ongoing IT maintenance when the HIS project was in the planning stage. These were some of the comments made by the interviewees regarding these matters:

“the management must also understand the need to spend money, because what I can see is that maintaining a hospital that is using IT is very costly, especially if it was not done in a correct manner. What I mean is when updates are not done, you wait too long to upgrade then the cost will be super extravagant”

[IT5, IT Department]

\(^1\) ITIL is an approach to IT service management which provides a cohesive set of best practice derived from public and private sectors internationally (ITIL 2011). The focus of ITIL is to align IT services with the needs of the business through procedures, tasks and checklists in order to establish the targeted level of competency.
“...IT personnel, they are not good at maintaining the servers...It’s about maintenance, not the system per say, there so many glitches, it puts people off.”  

[SD3, Clinical]

“Since the beginning, from the start until now, the same problems still...”  

[SD10, Clinical]

The HIS has to be re-evaluated and the IT governance structure has to come in when planning system maintenance. It has to be stressed to the senior management of the Alpha Hospital and the decision makers of the Malaysian Ministry of Health that IS/IT maintenance is one of the most important processes and thus needs to be carefully planned and delivered by the appointed IS/IT maintenance vendors.

The IS/IT maintenance process concerns the clinicians as the process of IS/IT maintenance and IS/IT upgrades have not been conducted in a proper manner, and this causes major setbacks and frustration for the end users. Most of the frustration for the end users revolves around the delay in getting the system up and running, and end users having to log a change request even for the most basic change or modification to the HIS. These are some of the comments regarding the process of IS/IT maintenance and upgrades:

“...basically it’s all about organisation, just let us know when you plan to upgrade, scale down the number of patients activity, that would be sufficient because you know there will be disruption, but if they just do it without informing us then ..(sigh) ..they just don’t understand the user implication, because we look after patients. .”  

[SD17, Clinical]

“with this system when you can’t look for something you would have to submit change requests, such a hassle. I wish the minor changes or upgrading can be done at the local level, meaning I myself can add new items on the list, new criteria, category...”  

[SD2, Clinical]

Apart from the IS/IT maintenance issues, the testing of new modules and functionalities was also reported to be poorly managed. Some of the concerns raised were the duration
of testing, that was considered to be too short and not structured to test all functionalities. A more protracted testing regime could have alleviated some of the problems faced by the end users. These are some of the concerns mentioned:

“...I feel the testing is too short....you test a little while then you go live...the complexity of patients can't be seen in a short while. Perhaps they should have given us some time maybe about 3 months for testing?”

[SD2, Clinical]

“...There should also be proper testing. Like right now, there is not enough testing than they just launch it so that creates problem.”

[SD16, Clinical]

A customized IT governance structure tailored to suit the needs of the Alpha Hospital’s IS/IT context is required to solve various issues especially in planning, change management, release management, IS/IT asset management, IS/IT maintenance and IS/IT technical support management.

4.5.5 Process: Clinical Governance

The second most commonly discussed process issue is the clinical governance structure within the Alpha Hospital. The daily routine of a clinician at the Alpha Hospital involves doing rounds in the in-patient wards, followed by long clinic consultation hours to the outpatients, and for some, performing scheduled surgery. In addition to their medical responsibilities, some clinicians are also involved with administrative tasks, including the preparation of administrative reports, purportedly with the assistance of the HIS. However, in many cases the HIS seems to be more of a hindrance than a help. Some of the comments made on this issue were:

“...the work load is too much and then there's no time to do it....especially when you are at the clinic and you are seeing so many patients, and you try to do that (some functions in HIS) so you may not want to do it, and then of course during peak hours when the system is slow, nobody wants to do that.”

[SD13, Clinical]
With using the system, every time we see a patient for an appointment....by the time the doctor clicks here and there, type in this and that, and as you know most people do not know how to type in properly, and they type everything, by the time you leave the room it would be about half an hour later, so the next patient's appointment is prolonged to another half an hour, so the list goes on and on to delay ...by the time you come to the last person he has been waiting maybe for 5 hours now”

[SD3, Clinical]

The clinicians were also asked in their interviews if they had followed any standard guidelines or best practices in delivering their medical services to the patients. None of them were aware of any practices or guidelines being used within the Alpha Hospital and the clinicians carry out their tasks as per Malaysian government public hospital practices inherited from previous generation and occasionally on an ad hoc basis as per directed by senior management.

With regard to the medical human resource management process, the main concern was that in any government institution the turnover rate of medical staff is relatively high. This is especially so with senior medical positions. The common practice of having heads of departments and senior clinicians transferred to another hospital due to promotion or completion of sub-specialty courses is very much a norm in public hospitals in Malaysia. Nonetheless, the common practices which have been exercised by the government for many years do promote some degree of frustration amongst staff of an IS/IT based hospital as they discourage the sense of belonging to the position, department and organisation. Some of the comments on the human resource management process are:

“...the problem is we have very high turnover rate, like all other government hospitals, very high turnover rate, people come they stay about a year or 3 years at most, only the old clinicians will stay for a long time, but the rest they just stay for training and they go for their training elsewhere.”

[Mr. C, Clinical & IT]
“I think in terms of IT staff also, well the Head changes so many times, so people come and go, so the continuity is not there, if this is to be our backbone then that department has to be very strong.”

[SD13, Clinical]

Another concern, albeit relatively minor, is that some of the staff use manual processes in human resource related matters, such as the application for annual leave, where one would assume that the HIS would have a basic application for the staff to apply for annual leave through the human resource module. Although the initial plan does incorporate a human resource management module as part of the administrative applications, due to financial reasons and the adherence to the standard government procedure of having centralized control over the human resource management and recruitment processes, the human resource management module was never realized.

4.5.6 Process: Financial

Financial issues can be seen as one of the main causes of why the assimilation of HIS is slow and in many ways unsuccessful. Almost all of the clinical and non-clinical staff suggested that there should have been more monetary investment or better management of the expenditure associated with the HIS. Had there been adequate funds supported by adequate monetary management, the system could have been very successful and met the ambition of being a showcase to the world. Nonetheless, the Alpha Hospital staff understood very well that due to difficulty in obtaining budget approval for IS/IT upgrades the issues with the current HIS will most likely be very difficult to resolve.

“no matter what cost plays a major factor, buying computers for every ward for every doctor is not cheap, especially at the time when they say it is the economic downturn and they are slashing our budget for medication, I do not think they have enough money to spend for all these IT stuff...the system costs money, the hardware costs money, the software costs money so it's not going to be easy...”

[SD1, Clinical]
“...we have to keep up, but financially it cannot, because it’s difficult...it is also expensive....to maintain it needs a lot of money... as a user, I wouldn’t want to change, I just want to make it better but it's costly..”

[SD13, Clinical]

“...rather than coming back to the station to look at the patient details...carrying notebooks during rounds is better, so now all our notebooks are dead...there is no money to buy new ones..”

[SD3, Clinical]

The IT staff also feel that due to lack of funds and poor monetary management, they are not able to achieve the best from their technical abilities. Frustration for the IT staff can be seen when the subject of requesting changes and upgrades was raised. The IT staff’s enthusiasm in writing new proposals for upgrades is slowly deteriorating as the requests have always been rejected due to lack of funding. Lack of funds and poor monetary management were reasons also used to justify to users of HIS when there are complains that are just not technically possible to solve. These are some of the comments made by the staff:

“Right now maintaining the hardware is also very costly, in just a few years’ time it's already obsolete..so every time we change that incurs cost.... right now due to financial barriers we cannot do things up to is optimum level, so we will usually go for options that are according to our budget. For example our disaster recovery and software options, there are many other good options but due to our budget constraint we could not go for that extra option.”

[IT5, IT Department]

“...and of course one of our major problem that we have is our hardware, within 3 or 4 years it's obsolete, and we don’t have support and funds, so it's very fast but our upgrading is not as fast as how technology advances, it costs a lot of money, so that's the problem”

[MD1, Management]

“But as we go we find some problems can be solved, and some cannot be solved, because we need extra funds and funds only come as per project, we have of course the operating
expenditure, which is just sufficient to continue what we do, but if you want additional things that would satisfy certain requirements you need extra money”

[Mr. C, Clinical & IT]

“...one more is the funding I think, for example now, I think in any government services it's like that, when you get something for example computers, you can get everything at once, but to upgrade, well that's a problem, upgrade software, upgrade hardware, imagine we had to wait 10 years or more to get things changed around here”

[MD2, Management]

The issues with the financial situation are actually causing some major setbacks, even to the very basic IS/IT necessities of the Alpha Hospital. In every organisation and especially in healthcare, the importance of data backup is crucial in order to ensure the patient’s safety and to act as a component of disaster recovery. The Alpha Hospital has no data backup solution because of the current poor financial situation.

“We didn't have backup before, now we do but not a fully mirrored backup because it is too costly for us. So what we do is only some parts we can fall over to the backup and some parts we just don't. This is all due to cost; we are operating on a very tight budget.”

[IT5, IT Department]

The Alpha Hospital management defended the financial short comings by justifying the budget and financial planning being done at the Malaysian Ministry of Health according to a five year plan, where Ministry staff decide on specific hospitals to be allocated funds for the duration of the five years. In the next five year planning cycle, the budget will be allocated to another one or two hospitals, depending on the government’s development plan. The Alpha Hospital management also stresses that medical equipment such as the Picture Archiving and Communication System (PACS), in the radiology department for the use of X-ray and other medical imaging services is very expensive. Therefore, cost effectiveness is strictly measured in ensuring that these systems are placed in hospitals that provide the services supported by them.

“...for example PACS, it's very expensive, so it was not cost effective to put in smaller hospitals that not necessary have a CT scan, maybe they just have X-ray, so you would
have to see the services offered by the hospital, the budget availability, so we made it in such a way that it should meet the level of service of the hospital...”

[MD1, Management]

The Alpha Hospital staff is also aware that running a hospital with an HIS is very costly especially when they know that the hospital is built for the purpose of revenue generation but relies on government expenditure.

“From what I see, running an IT based hospital is very costly. Especially when we are not a revenue generating hospital, we are a public service so we do not collect back the revenue to support back the system.”

[IT5, IT Department]

“I've put up a new system, mainly the infrastructure and the system software, this will cost us a lot of money, for that we would have to get into the Malaysia's plan, so this Malaysia's Development plan, the money is just not there.”

[Mr. C, Clinical & IT]

The champion made comments relating to the way funds were obtained and managed -

“..what we are interested is not getting money out of the HIS but getting the whole health delivery system from planning to actual delivery more effective and efficient. That is the return of investment, not the money. The money is unnecessary because we have tax money. It is just the matter of how much of the tax money that we want to use....

..we are not dependant on people because they have already paid their taxes, so in private practice is different, they concentrate on finances and all that, they will not invest on Decision Support Systems (DSS) and all because they need the money but here we have got an opportunity because we are not worried about getting the extra dollar from each patient, in fact we are better than the rest of the world who are worried about money, we are not. We are already under funding of health services....”

[Mr. C, Clinical & IT]

From this comment, it can be ascertained that it is quite unacceptable when money or budget constraints have always been the reason to deny people’s requests to try and improve and expand the functionality of the HIS. Money should not have been an issue since the government’s funding is based mainly on tax revenue. It can be concluded that
how the tax revenue from the Malaysian government was managed and allocated to the HIS development and expansion has caused some of the inadequacies in the assimilation of the HIS.

4.5.7 Process: Procurement

The procurement system in Malaysia was found to be subject to the risk of abuse, to unethical manipulations and to corrupt practices (Siddiquee 2010). The corruption stems from a weak procurement system that lacks aspects of appropriate ‘checks and balances’ causes a major drain on the national budget and can result in a huge loss of public funds (Siddiquee 2010).

This issue was also indirectly mentioned in some of the interviews.

“...the problem is that we have to submit our request, justify it and all that, then various level of government would have to say if it's okay, then finally the Ministry of Finance will give us the money. Then only we can do things, so quite often when you want something now you will get it one year or a year and a half later or two years later. And sometimes when you ask for certain amount you may only get half of it...you see those cameras on the computer, we actually asked that to do telehealth, teleconferencing. At first they do not want to give us, suddenly because of new project "poof" it's here, so it's not given by needs, somebody comes to the minister's office and said, “you know Mr Minister..this technology is good , we’ll do it nicely for you” and the person gets the project...but what do I need? To get from Pentium 2 to this, it was such a hue and cry.....”

[Mr.C, Clinical & IT]

The level of bureaucracy explained through the interview transcript above highlights the flaw in the way procurement processes is being carried out in Malaysia. Members of the clinical staff were dumbfounded by the ways procurement was managed and they have experienced very poor service provided by IT vendors who have won a procurement tender. This experience is highlighted by the respondents:
“I feel that there should be an improvement to the tendering system, I don’t understand Malaysia’s tendering system, please select vendors that can offer us the most value and after sales services.”

[SD2, Clinical]

“It is very important to have a solid vendor selection....some vendors come in through direct negotiation.... If there is a change in vendor it should be done through open tender”

[IT1, IT department]

The response above provided by the IT staff member explicitly suggests that the procurement process was not done fairly in the Alpha Hospital. Following the normal practice for government procurement process, vendors should compete in a tendering system and those providing the best proposal and with the best qualification should win the project. Clearly, some tenders did not undergo this process and IT vendors managed to be successful with their tender through direct negotiation with people having political influences.

4.5.8 Technology: Infrastructure

Being a relatively new public hospital, the infrastructure for the Alpha Hospital can be observed as being new and technologically advanced compared to other public hospitals in Malaysia. Nevertheless, there are some concerns over the network component of the infrastructure that is being provided, namely wireless technology access in the wards. The following comments were made by staff members about the hospital’s IS/IT infrastructure.

“The system is a client server, so we have got a thick client concept, we do have application servers but the application servers were low end.”

[Mr.C, clinical &IT]

“External issues of course broadband and network is one, wireless is another. There is only so much you can do with wireless, but as you know in medical field people do rounds, so there are a lot of limitations in terms of wireless, it slows down, so doctors get frustrated.”

[MD1, Management]
“...the current wifi system in the ward is terrible, there is only 1 laptop for the whole ward, and we have 2 specialists doing rounds at the same time, some will start from the front some will start from the back, so how do we share?”

[SD1, Clinical]

“...it's not that we want to go against or do not want to use it but with proper facilities and infrastructure, it would be fantastic...”

[SD2, Clinical]

During the interview with the IT department representatives, only general comments were made on the subject of the wireless network as they too agree with the clinicians that there are issues with access to wireless network even within the IT department.

The IT department also highlight that there is a need to improve their data centre in having a more sustainable and eco-friendly environment.

“...in terms of infrastructure right now we are looking into virtualization, and green data center, before this we had 100 plus servers, that causes major issues with electricity, heat, so don't just go for what's there...go for advanced technology like virtualization so we can manage better...”

[IT5, Non-Clinical/IT Department]

Despite the issues discussed by the staff on the weaknesses of the wireless system, most of the IT department staff feels that the management does not plan on improving the wireless system at the ward in the near future.

4.5.9 Technology: Software and Hardware

The issue of software was mentioned during the interviews as being more of a user interface issue. Most clinicians are much more concerned over the issues on hardware in the wards such as using servers with obsolete specifications, delays in retrieving data due to the hardware’s incapability of performing fast transactions and insufficiency of computers in each ward. These are some of the responses that showed annoyance towards the hardware issues at the wards.
“….and of course one of our major problem that we have is our hardware, within 3 or 4 years it's obsolete……so it's very fast but our upgrading is not as fast as how technology advances……so that's the problem.”

[MD1, Management]

“...these things have to be changed regularly...you can’t keep something like this for the next 25 years.”

[SD3, Clinical]

“I feel that the management should help us with these hardware issues..help us, help them...”

[SD2, Clinical]

“...you will find some doctors writing on paper and then go back to their computer to type them back. But that also comes with other reasons such as the insufficiency of the hardware, and there's wireless but when you go for rounds the wireless system is not as good as you expect. So these are the things that would make the users frustrated and the excitement will deteriorate, enthusiasm will be gone.”

[MD1, Management]

“...rather than coming back to the station to look at the patient details...carrying notebooks during rounds is better, but now all our notebooks are dead...”

[SD3, Clinical]

From the comments made by the respondents, it is obvious that the lack of hardware functionality leads to interference and sub-optimal performance of the clinicians work practices as opposed to the HIS being able to assist them in doing their daily job effectively.

4.5.10 Technology: IS/IT System Design & Performance

The HIS design and performance is one the largest issues discussed by all levels of staff at the Alpha Hospital. Most of the comments were concerned with the level of user friendliness and the inability of the system to meet unexpected situations. A lack of
robustness in the system which causes it to “hang” every now and then was also discussed by participants, as can be seen in the following discussions:

“..other than that I think user friendliness. It’s very important when we are designing the system we must think about the flow and how the doctors will use the system. So, the moment it is not user friendly the doctors will just refuse to use it.....Besides that the design of the system is already 10 years old, it's not as user friendly as the newer systems you have now, so this one still uses text to key in information...”

[MD1, Management]

“we wanted the data to be structured, we have put in too much structure in it, so much so that, people are reluctant to use the data entry form because the form is not relevant to the work that is being done or the event that was happening..”

[Mr.C, Clinical & IT]

In a dynamic environment such as the hospital, the tendency of getting unexpected situations is quite common (Yuqing 2007). The issue of not being sufficiently flexible in meeting some of the daily activities of the clinicians is raised by the participants below:

“...let’s say if someone walks in and they are not schedules for that day, so there’s no way to slot them in and you have to reschedule for another day, so you would have to know how to “beat” the system in order to slot them in... X-rays should also be able to be opened up through the laptops, because at the moment it is available only at selected PCs. Not all of the PCs have them. I don’t have it here in my PC, so if I want to have a look at the X-Ray I would have to go to the ward..”

[SD1, Clinical]

“If I’m seeing a patient today and I wanted to see what my colleagues wrote 2 weeks ago, I can’t see it immediately when I click on the patient’s name, I have to close this, open another application, retrieve the patients info click modify, then it'll come up. So, it's a hassle.”

[SD2, Clinical]

In addition to the concerns over the inflexibility and unfriendliness of the HIS interface, the current HIS technical performance and incompleteness were also issues discussed
during the interviews with the staff of the Alpha Hospital. The current technical performance in terms of response time is said to be rather poor due to the system being quite obsolete and a lack of maintenance by the IT department. In relation to the completeness of the HIS, it can be concluded from the interviews that the clinicians were looking forward to the promised data mining and analysis tool to assist them in producing trends or statistical analysis of medical conditions and treatments, and are disappointed that they do not have these facilities. Below are some of the comments made on this matter:

...auditing is good but to retrieve information you have to do it manually...the aspect of automation is not there. That's the sad part...the process is still manual but the data is just there sitting in the computer..”

[SD17, Clinical]

“...if you are talking about performance, we are not at the peak of our performance...this is because of the obsolescence of the system, hardware but we are right now in the process of upgrading. So, we are having a lot of problems right now, in terms of performance because the system is almost 10 years old...”

[MD1, Management]

“..it's just that it hangs, on and off quite frequently. It's very slow especially if it hangs and they want to look at the X-ray of the patient, it’s very slow...”

[NC3, Non-Clinical]

Generally the staff of the Alpha Hospital feels that there is a need to have a better design for the HIS, comparable to the HIS specifications of the original HIS plan. This matter was also discussed with the IT department staff and they agreed that in terms of being up to date with the latest healthcare IS/IT technology they are quite far behind. In order to make clinicians happier and more content to use the HIS, there is a considerable need to develop the HIS to be able to offer new tools and more effective applications with intuitive interfaces.

4.5.11 Technology: Integration Issues

Part of the Malaysian government’s Telehealth plan is to integrate an Electronic Health Record for the entire nation. However, the basic integration between modules in the HIS
of the Alpha Hospital is problematic and incomplete. In order to achieve the nationwide integration of the HIS, the integration issues of internal cohesion and integration with other HIS hospitals within the vicinity of the Alpha Hospital need to be resolved. The issues of integration have been mentioned frequently in most of the interviews with the clinicians.

“I need the information fast, but then I now have to open this window first, close it, open the previous one, wouldn't it be nice if the notes were integrated? There's so much to fill in here and there, there’s no linking to my diagnosis for that patient, if I reschedule this patient then it's just the patient information but to see what I wrote last week, I have to open another application, key in his medical record number (sigh)… you see the integration is not there.”

[SD2, Clinical]

“Apparently now there is also a problem of transition from the old software to the new software, something about the two software not being able to talk to each other... So because of that we can’t retrieve any images before 2009”

[SD1, Clinical]

With the ever increasing number of patients in Malaysian public hospitals, people of Malaysia tend to flock to hospitals which are frequently publicized in the general and government media as being the best technologically equipped hospitals with the latest and most advanced information systems. Despite the promises made by the government in improving the healthcare facilities, the hospitals still do not have enough beds and despite the media reports of having the latest technology, the data from one hospital to another is very much independent and not integrated. Hence, the occurrence of redundant patient records with the possibility of having different diagnoses may appear in two different hospitals. The clinicians at the Alpha Hospital were also concerned with this matter as it would have been easier for them to assess the patient if there was the one complete medical history on a patient across the whole Malaysian hospital system.

4.5.12 Environment: Political Influence

The political influence in the healthcare industry in Malaysia is dominant to any of its other government ministries and agencies. The criticisms of the public sector, including
public hospitals, have always been about their inefficiencies, red tape, lack of flexibility, ineffective accountability and poor performance (Siddiquee 2006). It is common after each national election, administration under a new Prime Minister promises administrative reforms and reorganisation to address these ailments in order to enhance efficiency in the performance of public bureaucracies (Siddiquee 2006). Various reformation plans were outlined by the newly or re-elected government with the ambition of being competitive with other developing countries in the advent of globalization (Siddiquee 2006). There was a need to redesign governmental processes in order to provide service excellence (Siddiquee 2006, 2010). Nevertheless, having been in a legacy system environment for over 5 decades, changes in government processes, including healthcare policies, are very difficult to accomplish due to resistance in changing current processes which provides a more transparent approach (Ibrahim 2009). Although the Malaysian government has launched its vision 2020 plan for incorporating IS/IT as the backbone of every future initiative to the year 2020, and this plan includes healthcare reform, the actual implementation of these plans and projects is not as progressive as it was intended to be (Yow 2010). The political influence at every stage of the assimilation process is considerable and causes many obstacles for the success of the HIS assimilation. Some of the comments made by the participants on political influences into HIS assimilation projects include:

“Political! always political….. not moving because in Malaysia every other fellow wants to make money out of everything. That’s why it's not moving...when this hospital was built, we were supposed to be a showcase to the world, and the then Prime Minister said money is no problem, he said, there will be no local company no middle man, go and find them bring them here and do the system.... When they were successful here earlier, then they wanted to build another hospital, that’s where politics starts, this company got this contract for that hospital, this company got another contract for another hospital, contract for this and that, then it's all a mess....”

[SD3, Clinical]

“You have to understand Malaysia. Malaysia has a lot of political influence... it's very sad when you know we are controlled by one organisation but very fragmented...the
Data & Analysis

Health Ministry should organize it better, take control of it....The Ministry of Health like many of our other ministries there's a lot of "unexpected revelation"...it's difficult....difficult...."

[SD17, Clinical]

"....one thing is the business model, the way we do work, is mainly projects, projects, projects, whereas other places the users demand we want IT here and there, and they work for it, over here suddenly we have something coming down from the ceiling, suddenly there's a new computer there."

[Mr.C, Clinical & IT]

The existence of a middle man in many Malaysian projects is a legacy from the second Prime Minister’s ruling during the 1960s (Ibrahim 2009). Initially the “middle man” concept was a privilege given to an ethnic group of Malaysia known as the Bumiputeras, consisting mainly of Malays who were in financial difficulties (Ibrahim 2009). Their appointment was an attempt to improve their living standards and this situation led to the introduction of the National Economic Policy (NEP) where the objective was to help the poor, eradicate poverty and provide the Malays with business opportunities (Roslan 2001). However, the former Prime Minister used this idea to justify his new ideology of creating a capitalist group, consisting of Malays, by giving projects to those who are considered qualified and authoritative (Ibrahim 2009; Roslan 2001). Today, with the new policy, known as National Development Policy (NDP), replacing the NEP, an increase in the number of Malay capitalists and the extension of opportunities to the component parties who are in support of the leading ruling party has developed (Ibrahim 2009). Hence, today the Malays who are poor are still trapped in the quagmire of poverty (Ibrahim 2009).

In the case of the Alpha Hospital, the IT maintenance vendor is seen as one of those capitalist groups which clearly portrays the comments of Ibrahim (2009) that local companies tend to become greedy when they think they are entitled by the privileges bestowed upon them to siphon off and squander public wealth.

"....when we built this hospital, if we were to use the telehealth model, we would have this hospital and all the peripherals, and other services will speak to another hospital
somewhere else. We should be connected and they should use the same application system so we can refer back cases, send x rays. I've been writing papers about that, but it's not happening because different parties are involved, even now 11 years after we are buying new system for this hospital, I cannot get the ministry to say “okay don’t just buy for your hospital, buy for hosp C, D and E so we can have telehealth. But is not there...”

[Mr.C, Clinical & IT]

It is these actions by the capitalist groups in disseminating project management that compromises the hospitals in Malaysia integrating with each other.

4.5.13 Environment: Work Culture

The typical working culture of a civil servant in Malaysia portrays that one should never be too clever, should not give ideas or propose new things even though you are seen as a person with power in your organisation and the desire to bring about change or thinking dynamically will be considered as a threat or interpreted as challenging your superior (Ibrahim 2009; Mastor, Jin & Cooper 2000). When people are outspoken and make numerous constructive or negative comments, they will be assumed to be bringing new culture and become troublemakers (Ibrahim 2009). Therefore, the civil servants normally adhere to any policies, rules, and say only what the leader wants to hear even if it is clearly seen as a mistake. The consequences to staff for being outspoken or providing constructive critique are in the form of a work transfer to other locations, position removal or in extreme cases being sacked. This is also implied in some of the interviews as transcribed below. Although at the time this matter was brought up the participants responded with meaningful smiles and laughs, but it was clearly implied that unstated rule and culture do exist.

“If you are out of step with the ministry, then you might be called up, or reprimanded or whatever...because you are trying to change......so this part, we say we want people to innovate and all that, well it doesn't happen.”

[Mr.C, Clinical & IT]

“I would have told you more on the issues but I like it here, if I go overboard and it was discovered, I might be transferred somewhere remote.”

[IT4, Clinical & IT]
With regard to voicing their dissatisfaction with the Alpha Hospital’s HIS, most participants feel that since the submissive culture is so apparent in government institutions, they would try to adapt to the system and share their complains amongst each other but not to the higher management. There is also the culture of “not being accountable” in Malaysia thus a “finger pointing” culture is very common when problems arise.

“Well, you just have to learn to work with it, you learn to “beat” the system on and off, you learn to adopt it, work round it..”

[SD1, Clinical]

“When we complain, then they say oh that's maintenance job, oh that’s developer's job, this one is vendor's...so, no point complainting...”

[SD2, Clinical]

“When there is a problem and if we complain then that starts the blame game. We blame the IT department for not giving the right application; the IT department blames us for not using it right...”

[SD12, Clinical]

Nevertheless, some of the submissive behaviors to the higher management do bring about a form of success to the use of HIS at the Alpha Hospital. For example some of the interviewees feel that:

“.we were lucky that when we started here long time ago, all the core group including the head of department is here, so whether you like it or not the lower rank has to follow and use it”

[MD2, Management]

“...if there was no directive from the higher management it would be a bit difficult. But when the Medical Director says you have to do it in such and such way the success would be greater.”

[IT5, IT Department]

“In Malaysia , the rule is that order entry has to be done by doctors or nurses, for example doctors write the order but the nurses will do the labelling and all that, so the
Culture is already there, we don’t have to push the doctors. Adoption in that sense it is very dependent on supervision, there is a need to have someone make sure that everybody is doing what they are supposed to do.”

[Mr. C, Clinical & IT]

Therefore, there is a need to find a balance in the work culture especially in public hospitals (Siddiquee 2008). Although the submissive culture may be good at times, freedom to express opinions for the sake of patient’s wellbeing and needs must be apparent and opinions taken into considerations and acted upon.

4.5.14 Environment: Government Regulations

Being under the administration of the Health Ministry, the Alpha Hospital is obliged to adhere to the regulations, guidelines, policies and procedures outlined by the government and any relevant government agencies or ministries. These regulations have been in place for a number of years and require a form of change or amendment when there is a plan to assimilate IS/IT throughout the organisation (Siddiquee 2010). With the current obligation of having to meet the requirements of these regulations, this may deter the hospital undertaking wide usage of the HIS as there are conflicts with manual processing. Some of the comments made by the participants on adhering to the government regulations were:

“Again policies are pretty standard throughout; we have to actually adhere to the policies of the MOH.”

[Mr. C, Clinical & IT]

“Other external issues are when you have documents which are government controlled, for example the permits and MCs, computer generated may not be accepted, so you still have to go back to paper.”

[MD1, Management]

“The e-procurement and HERMIS system is a direction from the government in its e-government plan, so every government institution must use.”

[IT5, IT Department]

Adhering to some of the government policies does limit the use of the HIS and provide difficulties in changing certain aspects of the hospital’s processes. For example, there
have been plans from within the Alpha Hospital for merging the medical record office with the IT department since they both involve managing the HIS but in different areas. The medical record office undertakes information management whereas the IT department oversees the technical support and IS/IT management. However, it is difficult for the Alpha Hospital to undertake this merger as there has to be a policy or direction from the Malaysian Ministry of Health. A similar situation would prevail if the Alpha Hospital planned to make changes to the human resource management processes to be able to retain staff for the Alpha Hospital since they have already been trained in using the HIS of the hospital.

In trying to successfully assimilate HIS, the issue of change management must actively involve the hospital’s senior management in high level meetings with the staff of the Malaysian Ministry of Health in planning change. Policy makers within the Ministry should also be aware of and exposed to the current IS/IT issues in healthcare to ensure suitable policies are created for future HIS hospitals.

4.5.15 Environment: Leadership

The leadership structure of a public hospital in Malaysia consists of multiple levels of authority. As depicted in Appendix 2, the top management consists of the Minister of Health, Deputy Minister of Health, the Secretary General and Director General of Health. The next level consists of a line of Deputy Director Generals in charge of several divisions, including medical development, medical practice, allied health and nursing. A level below a Director General is the respective medical directors of each state or tertiary hospital. With regard to good leadership on the assimilation of HIS at the Alpha Hospital, most interviewees felt that leadership plays an important role in the initial stage, especially with the existence of the clinicians who were among the HIS initial project team members. These are some of the comments made by participants from the Alpha Hospital on leadership:

“When we started the success factor was the leaders, Head of Department (HOD) are chosen among people who wants to work with computers. They might not be computer savvy but they are willing to learn.”

[Mr.C, Clinical & IT]
“The first stage itself the most important thing is leadership. So, you must have a committed leader at the top that will push us for this, and you need to have the buy in from all the clinicians.... So what we did is the clinical leadership was also important, not only the hospital leadership but also a leader among the clinicians is also important. So that's how we became very successful. At that time we had a core team of all the specialists and head of department that was for IT, like our champion that was the kind of leadership we needed to be successful.”

[MD1, Management]

“...we were lucky that when we started here long time ago, all the core group including the head of department is here, so whether you like it or not the lower rank has to follow and use it..”

[MD2, Management]

when we first started this project, previous director general guided us, we all were happy to come here but if you decide to bring your "Baggage" with you from elsewhere, then please leave...in other words it's trying to tell you need to have your mindset changed and be into it”

[SD13, Clinical]

It can be seen that, as the assimilation progresses to different stages, there is some sense of a lack of leadership and the hospital management’s understanding on some of the proposed initiatives such as upgrades and purchasing of new hardware in replacement of obsolete versions that are required to be carried out in improving the HIS. The participant’s sense of a lack of leadership and misunderstanding were not only targeted at the hospital’s management but also at the management in the Malaysian Ministry of Health because assimilation involves budget and financial matters which are mostly controlled at the ministry level. These are some comments made by the clinical and non-clinical staff of the Alpha Hospital:

“...the management support is very important, and the management must also understand the need to spend money, because what I can see is that maintaining a hospital that is using IT is very costly, especially if it was not done in a correct manner. What I mean is that when updates are not done, wait too long to upgrade then the cost will be a bomb... the problem is when they don't understand, if they do it would be easier
for us. We can see the difference when we had the previous Medical Director who was someone that has been in this hospital for long time, so to deal with the Med Director in these issues was easier, and we gained support.”

[IT5, IT Department]

“...when you have management who come in that doesn't understand how things work, what is the easiest way that they decide when they do not know how to work these things? Okay, we go to filing. Look at all this work manual, work order manual. By right all these should be electronic...”

[SD3, Clinical]

Some of the comments on leadership also implied that in order to achieve the objective of being efficient and producing quality work, it is not up to the HIS solely to realize the results for the organisation. The HIS is there as a tool to assist staff in doing their job more effectively. It is up to the staff, especially those concerned with clinical governance leadership, to ensure that with the assimilation of HIS the hospital is more active and efficient in producing a safe, efficient and quality environment for its patients.

4.6 Findings

The findings of this study which were discussed in the previous sections warrant further consideration in relation to other aspects highlighted or unexpectedly discovered beyond those of the literature review in chapter 2. Hence, another level of analysis is required to determine the Expected Findings (EF), Emerging Themes (ET) and Significant Findings (SF). The expected findings (EF) are those which are discussed in the literature review and relate to the conceptualization of the initial conceptual framework. The emerging themes (ET) are themes discussed extensively during the interviews and were found to be relevant for hospitals assimilating HIS. The significant findings (SF) are tailored specifically to the findings which are significant only to the Malaysian context in assimilating HIS in public hospitals as based on interview data. These issues were found to be significant and need to be highlighted in order to eliminate difficulties and barriers of successfully assimilation HIS. Table 11 reveals the findings category on each discovered theme.
4.6.1 Expected Findings (EF)

Based on analysis of the interview transcriptions, of the seven elements positioned under the technology-organisation-environment context, only four elements were regarded as being important contributions to the HIS assimilation. The four elements are clinical IS/IT experts, IT governance, healthcare IS/IT infrastructure and regulation.

As expected, the need for people with both clinical and IS/IT knowledge is critical in ensuring the success of HIS assimilation. This is especially crucial in meeting the IS/IT requirements of the clinical staff and translating the requirements to the IT department for better understanding.

The conceptual model highlights the need for IT governance that could contribute to the success of HIS assimilation. In the context of a new IS/IT public hospital, the organisational processes consisting of both clinical and IT governance has to go hand in hand in providing a solid foundation for the assimilation to take place (Smaltz, Carpenter & Saltz 2007).

The IS/IT infrastructure as discussed in the literature review comprises of networks, programming languages, operating systems, workstations and other basic technologies that form the foundation for the applications (Glaser 2002). In line with Glaser’s (2002) definition, IT infrastructure in this study includes the use of programming languages and
operating systems which can be similar to the definition of software as mentioned in the interviews. Hardware should also be included under the IS/IT infrastructure category since the networks, workstations and basic foundation technologies are also included in the classification.

Finally, as identified from the interviews is government regulation under the environment context. As discussed in the literature review, a healthcare organisation needs to abide to any regulatory changes and implementation (Chee & Barraclough 2007) as the government’s regulatory influences would have an impact on the HIS assimilation in a hospital. These impacts might involve HIS assimilation in terms of support and funding (Chee & Barraclough 2007).

**4.6.2 Emerging Theme (ET)**

The assimilation of HIS at the Alpha Hospital was found to be susceptible to HIS system design and performance, financial capabilities, training, integration and organisational processes. These themes were frequently mentioned by the interviewees. Due to being rather obsolete, the HIS design and performance is of concern among many clinicians as they require efficiency and robustness in a system that is able to sustain its uptime at all times. With regard to financial processes, almost all of the interviewees responded to financial issue(s) when asked about the main contribution to a successful HIS assimilation. Some interviewees also made clear their dissent at this issue especially when it is well understood that a public hospital should not be concerned with financial matters since public hospitals are under the health services funding through tax payer money. Whilst discussing the financial issues, the integration issue emerged as the lack of integration between applications in the HIS was blamed partly due to the lack financial capability. This was a major concern, mostly by clinicians who would really appreciate interaction and cohesion between the modules in HIS to expedite their tasks.

Procurement processes also became an emerging theme that was illuminated during the interview and was anticipated to be a contributor to the HIS assimilation. Nevertheless, the manner in which the procurement system is being used is very questionable with regards to the appropriateness for a public healthcare facility. The issue on the Malaysian procurement system will be discussed in further detail in the next chapter.
With regard to leadership, this element was vaguely discussed in the literature under the managerial obstacle component. As discussed in the literature, the managerial obstacle refers to the organisation’s lack of managerial skills and efficiency in handling change management, thus this causes the ineffectiveness of managing technology adoption and adaptation (Roberts et al. 2003). This may also involve leadership issues as discussed and analysed through the interviews at the Alpha Hospital, where there is a dire need for strong leadership especially equipped with the ability to merge managerial and IS/IT skills in assimilating HIS.

4.6.3 Significant Findings (SF)

This study also revealed findings which are significant in the context of public hospitals in Malaysia. Being a post-colonial country influenced by British rule together with a culture of being submissive to the ruling authority has brought about some hindrance towards improvisation of HIS due to the existing bureaucratic nature. With the existence of bureaucracy, the existence of political influence is apparent. The reliance on hospital top management in making strategic decisions in improving the HIS is very questionable especially when the final say is mostly in the hands of the Malaysian Ministry of Health which may consist of people without prior medical experience and especially without IS/IT knowledge. The appointment of incompetent IT vendors through political influence has been noted to be one of the root causes of the chaos in the assimilation of HIS in public hospitals in Malaysia. As these vendors are selected mostly based on direct negotiation at the ministry level, the background knowledge in healthcare IS/IT is not the main criteria for selection. The IT vendors act as a third party component in liaison with the main healthcare IS/IT solutions providers, that are mostly international companies sub-contracted to carry out the assigned IS/IT deployment and maintenance activities.

As a consequence of these unsatisfactory issues, two major results were identified to be significant in ensuring that the HIS is assimilated successfully in public hospitals. The results are concerned with the issue of trust and goal alignment. Trust issues have been identified as a result of the political and culture influences at the Alpha Hospital in which it involves both top-down and bottom-up flows in the organisation. As an example, the management has issues trusting the subordinates using their own laptops to access the
HIS due to security reasons. This defeats the purpose of having to use the HIS anytime anywhere at the convenience of the clinicians in carrying out their duties. The security reason used by the management is also due to trust issues that they have with the local IT vendor in failure of providing the right amount of security on the HIS according to the requirements.

Furthermore, the medical staff of the Alpha Hospital also insinuated that they are not in the position to voice any opinions to the higher management with regards to HIS as it is understood that the final decisions on any improvisation to the HIS will come from the Malaysian Ministry of Health and decisions are usually made independently with minimal contribution from the Alpha Hospital. In regards to goal alignment, it is also noted that with the involvement of the local vendor in maintaining the HIS, there is a sense of misalignment of goals between the hospital and the local IT vendor. Should the goal of both entities be aimed at providing the best service to the users of HIS through minimal downtime and frequent upgrades to be at par with latest technological capacity, then the success of the HIS assimilation is undoubtedly going to be greater and perhaps even beyond expectations. Nevertheless, this has not been the case for the Alpha Hospital with the local IT vendors involved.

4.7 Summary
This chapter presented all the results from the transcribed interviews involving the clinical and non-clinical staff’s responses and reactions towards the use of HIS in the Alpha Hospital in order promote the HIS assimilation. The views and experiences of the two participants group were compared where the findings indicate similar issues being discussed with both groups pertaining to people, process, technology and environment. The attitudes of clinicians using HIS, the lack of clinicians with IS/IT knowledge and selection of the suitable IT vendors are among the common people issues being discussed. In terms of technology, both clinical and non-clinical staff identified many functions and features of the HIS that were problematic and obsolete. On proposing upgrades as a solution to the technology issues, led to the next component which is the organisational process. The organisational process involves issues of IT governance, clinical governance, financial and procurement. Further discussion on this component
initiated the environment issue which led the participants to discuss on political influences, public service work culture, government regulation and leadership.

Further analysis and coding of the transcription identified the expected findings as per the initial conceptual model, emerging themes and significant findings predominantly to the Malaysian context. A detailed discussion on the results in the context of the initial conceptual framework, implications to the hospital, the study and theory will be presented in the next chapter.
CHAPTER 5

5 Discussion

Based on the literature and the conceptual model, seven identified concepts from diffusion innovation (Rogers 1983, 2003b), technology-organisation-environment (TOE) (Tornatzky & Fleischer 1990) and the resource based view of the firm (Bharadwaj 2000; Grant 1991, 1995; Huang et al. 2006; Khatri 2006; Ross, Beath & Goodhue 1996) were examined in conjunction with the three HIS assimilation stages in order to investigate reasons for the existence of assimilation gaps. The results of this study revealed mixed support for existing innovation assimilation theory, and unexpected themes emerged, providing a deeper understanding of the interaction between people in the hospital and the HIS technology. Based on these findings and emerging themes, changes were made to the HIS framework to include people, process and technology elements from sociotechnical systems theory (Bostrom & Heinen 1977) in combination with the existing selected theoretical frameworks. Further analysis of emerging themes indicated that there are several barriers and facilitators to the HIS assimilation success.

The barriers are categorized into global barriers throughout the entire assimilation process, and local barriers specific to each assimilation stage. These barriers were found to be significant, and in agreement with the findings of Poon et al. (2004), highlighting that strong leadership, high-quality technology, financial incentives and regulations are among critical barriers that hospitals should overcome when adopting and implementing healthcare technology. The informants of the Alpha Hospital provided some suggestions and strategies to overcome these barriers specifically to the Malaysian hospital context.

In order to provide an in-depth understanding of the results, this chapter consists of discussion on each of the main components of the research framework (sections 5.1, 5.2, 5.3, 5.4 and 5.5), barriers to the HIS assimilation (sections 5.6, 5.7, 5.8 and 5.9), the HIS assimilation research framework (section 5.10), case study reflection with lessons learnt (section 5.11) and the chapter summary (section 5.12).
5.1 Four Contextual Components of the Research Framework

The initial framework first presented in sub-section 2.5.1, identified seven elements that underpinned this study in developing the conceptual model. However, the findings of this study identified four main contextual components of the research framework, consisting of people, process, technology and environment concepts. Table 12 below revisits the elements from the conceptual model. In comparison, Table 13 reveals elements that were identified as facilitators from the analysis of the data and illustrates consistencies with the initial conceptual model.

Table 12  Identified Elements from Conceptual Model

<table>
<thead>
<tr>
<th>Context</th>
<th>Element</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology</td>
<td>IT Governance</td>
</tr>
<tr>
<td></td>
<td>IT Infrastructure</td>
</tr>
<tr>
<td></td>
<td>IS/IT enabled intangibles</td>
</tr>
<tr>
<td></td>
<td>Hospital IS/IT Experts</td>
</tr>
<tr>
<td>Organisation</td>
<td>Hospital Size</td>
</tr>
<tr>
<td></td>
<td>Managerial Obstacle</td>
</tr>
<tr>
<td>Environment</td>
<td>Regulation</td>
</tr>
</tbody>
</table>

Table 13  Identified Elements for Research Framework

<table>
<thead>
<tr>
<th>Context</th>
<th>Element</th>
<th>Consistency with initial conceptual model</th>
</tr>
</thead>
<tbody>
<tr>
<td>People</td>
<td>Clinical IS/IT Experts</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Medical Staff</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Vendor</td>
<td>No</td>
</tr>
<tr>
<td>Process</td>
<td>IT Governance</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Clinical Governance</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Financial</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Procurement</td>
<td>No</td>
</tr>
<tr>
<td>Technology</td>
<td>Healthcare IS/IT Infrastructure</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Software and hardware</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>System Design</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Performance</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Integration</td>
<td>No</td>
</tr>
<tr>
<td>Environment</td>
<td>Political</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Work Culture</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Regulation</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Leadership</td>
<td>No</td>
</tr>
</tbody>
</table>

The study’s findings indicate that out of seven initially identified elements, only four elements were consistent with the conceptual model. These four elements are the clinical IS/IT experts, IT governance, healthcare IS/IT infrastructure and the regulatory environment. The clinical IS/IT experts and healthcare IS/IT infrastructure elements
provide support to the theoretical underpinning of the resource based view of the firm, in which the human IS/IT resource and IT infrastructure are considered to be of importance in the adoption of information systems (Huang et al. 2006). The utilization of these resources is also arguably able to leverage technology usage thus providing success to technology innovation (Bharadwaj 2000; Grant 1991, 1995; Huang et al. 2006; Khatri 2006; Ross, Beath & Goodhue 1996). The IS/IT enabled intangible element of customer service skills and knowledge, which was identified initially as a resource that could provide success to HIS assimilation, was scarcely discussed among interview participants. Further analysis indicated that these intangible elements were more of a barrier than a facilitator to the Alpha Hospital. These barriers will be discussed further in subsequent sections.

The regulation element was an expected finding as the context of the case study was in a public hospital that adheres to all regulations posed by the government. The regulatory environment confirms the argument of Chee & Barraclough (2007) that healthcare organisations should abide by any regulatory changes and implementation as the government’s regulatory influences would have an impact on the HIS assimilation in a hospital. The regulatory element also supports findings of Zhu, Kraemer & Xu (2006) whereby regulation does actually provide an influence to the success of the technology assimilation.

The following sections will discuss in detail the four components derived by merging the theoretical concepts of the sociotechnical systems theory (Bostrom & Heinen 1977) with the existing TOE framework (Tornatzky & Fleischer 1990), technology innovation and other supporting theories in healthcare IS/IT.

5.2 The People Context

Three of the main findings under the people component are to have clinical and non-clinical staff equipped with IS/IT knowledge, proactive involvement of medical staff in assimilating technology and competency of IT vendors in delivering the HIS technology. It has been mentioned numerous times by the champion when he specifically states that:
“...actually we should have more people who knows both sides...the work itself the operation and a bit of IT, and a lot about information management, data management”

[Mr.C, Clinical & IT]

Table 14 illustrates elements identified which facilitate assimilation success under the “people” context and show consistency of findings with existing theories.

Table 14  People Context

<table>
<thead>
<tr>
<th>Theme</th>
<th>As per conceptual model</th>
<th>Consistency with theory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical IS/IT experts</td>
<td>IS/IT Experts</td>
<td>The need for medical personnel to be equipped with information technology skills and tools is essential for future medical practice (McNeil et al. 2003)</td>
</tr>
<tr>
<td>Medical Staff</td>
<td>-</td>
<td>Physicians, nurses, pharmacists and other types of healthcare providers all need to become more involved in advocating for and developing IT in healthcare (Bates 2002)</td>
</tr>
<tr>
<td>Vendor</td>
<td>-</td>
<td>Organisations in search for the best vendor, should clearly understand that the process of vendor selection and evaluation is very important and should be treated seriously (Michell &amp; Fitzgerald 1997) It is one of the most critical steps in the outsourcing process as success of the outsourcing project is highly dependent on successful selection of vendors (Wadhwa &amp; Ravindran 2007).</td>
</tr>
</tbody>
</table>

With respect to the literature review in chapter 2, the issue of having clinicians with IS/IT knowledge and creating roles for clinicians to be IS/IT experts and simultaneously perform their daily clinical routine is scarcely supported. The literature highlights the importance of having a champion (Lee, C-P & Shim 2007), the lack of knowledge and training in using computers in the medical field (Hebert 2000; Henry & Stone 1999; Pare & Elam 1999) and the involvement of medical personnel as users in the HIS implementation (Katsma et al. 2007). However, the literature did not specifically address the type of knowledge that the champion should acquire nor does it describe the consequences of the exposure on knowledge and training of the medical personnel. The argument regarding the lack of computer knowledge amongst medical personnel was primarily aimed at ensuring better usage of technology in the medical facility and to promote the involvement of the medical personnel in HIS decision making as part of the IT department team. Nonetheless, the studies on the implementation of an enterprise application integration in the healthcare field have argued that practitioners with
integrated knowledge and the ability to provide training to the IS/IT staff should be hired for a healthcare IS/IT position (Khoumbati, Themistocleous & Irani 2006). In support of this argument, this research further argues that medical professionals with IS/IT technical knowledge should hold a position in the IS/IT department to work hand in hand with IS/IT staff throughout all the stages of HIS assimilation. This is to ensure that knowledge gaps between IS/IT and the medical field are bridged through sufficient knowledge of both areas in order to avoid assimilating medical systems that do not fulfil medical practitioner’s needs and work processes.

5.2.1 Implications and Recommendations for Practice

One of the first steps in initiating the HIS assimilation project is to have a knowledgeable group of project committee members comprising active HIS users from every department in the hospital. The critical team members should consist of clinicians from each medical department, nurses, medical assistants, pharmacist, allied health professionals and an administrative representative. The team members should portray an attitude that although their knowledge in IS/IT may be scarce, they are positive thinkers with optimism and are willing to put in an effort to learn. However, the project leader of this committee has to be someone who is highly knowledgeable in both clinical and IS/IT areas, and who possesses strong charisma in leadership and communication skills. As highlighted by the champion:

“When we started the success factor was the leaders, people who wants to work with computers. They might not be computer savvy but they are willing to learn…. we should have more people who knows both sides...the work itself the operation and a bit of IT, and a lot about information management, data management…”

[Mr. C, Clinical & IT]

For a successful HIS assimilation project undertaking, there has to be a reorganisation of the IT department in the Alpha Hospital where the management team should comprise of a Chief Information Officer (CIO), chief technology officer (CTO), chief security officer (CSO) and chief medical informatics officer (CMIO). Each position must be held by a person with high integrity, ethical values and strong leadership qualities. Each position must be supported by a team of competent systems analysts, database administrators,
programmers, network specialists and technical support personnel. Having a strong management team with the appropriate experience in both IS/IT and the medical field would provide a strong vision towards fulfilling the healthcare IS/IT strategies and goals. This is crucial for the Alpha Hospital especially when the IS/IT services are outsourced to an outside IT vendor. There is a need to align the hospital’s IS/IT strategic goals with the selected IT vendor organisation to ensure high quality delivery and support is provided to the IS/IT operations of the Alpha Hospital.

It is also important for the IT department’s management team to conduct frequent assessment of the selected IT vendor company with respect to the efficiency and effectiveness of their IS/IT services. The IS/IT technical support process, number of cases solved per week, number of support calls escalated, and user satisfaction with the service provided are some of the key elements that should be assessed. Assessment results should be made transparent and the appointment of an independent consultant could be used to assess the vendor to avoid internal assessor bias.

5.3 The Process Context

Within the process context, this research reveals that organisation’s core business processes are one of the main issues that must be addressed in successfully assimilating IS/IT systems in organisations. This issue of organisational core business processes is also supported by many articles in the healthcare IS literature, which suggest that one of the obstacles to successfully assimilating IS/IT systems in organisations is their capability in managing the organisation’s core processes (Bush et al. 2009; Hsiao et al. 2009; Lee, C-P & Shim 2007; Leu & Huang 2009; Naing, Zainuddin & Zailani 2008; Rinderle-Ma et al. 2010). Table 15 illustrates the findings from the Alpha Hospital relating to how the facilitators of the process context are consistent with the existing healthcare IS/IT theories.

Table 15  Process Context

<table>
<thead>
<tr>
<th>Theme</th>
<th>As per conceptual model</th>
<th>Consistency with theory</th>
</tr>
</thead>
<tbody>
<tr>
<td>IT Governance</td>
<td>IT Governance</td>
<td>IT governance is required to ensure that IS/IT is aligned with organisation goals and objectives in Cater-Steel &amp; Tan (2005)</td>
</tr>
<tr>
<td>Clinical</td>
<td>-</td>
<td>A strong clinical governance represents a systematic joining up of</td>
</tr>
</tbody>
</table>
IT governance was the only element found to be consistent with the theoretical model tested at the Alpha Hospital. The issue of having a more structured process in the IT department and the need for having to follow certain guidelines to improve current IT service management processes, such as support, incident and problem management, change management, IS/IT infrastructure management, security management and application management, is highly implied by almost all interview participants and especially the IT department staff. Therefore this element is in support of the argument of Cater-Steel & Tan (2005) and Wager, Lee & Glaser (2005) that IT governance is required to ensure that IS/IT is aligned with the goals and objectives of the organisation.

Clinical governance was discussed by most clinicians at the Alpha Hospital as being one of the main facilitators to successfully sustaining the use of the HIS in the hospital. Strong clinical governance in the healthcare organisation should portray a systematic joining up of initiatives by both the management of the healthcare organisation and, if relevant, the governing body. In the case of the Alpha Hospital, the Health Ministry has to produce strong clinical governance in each of the healthcare premises in order to improve quality of patient care (Scally & Donaldson 1998). The improvised clinical governance must also be supported by new approaches and innovations to healthcare technologies which are capable of providing improvement to the standard of care (Halligan & Donaldson 2001; Khoumbati, Themistocleous & Irani 2006; Scally & Donaldson 1998).
The financial investment in HIS will not only incur continuous increase in value but also become a rising issue in many healthcare organisations in the future (Bernstein, McCreless & Côté 2007). Public hospitals are faced with the challenges of improving service quality and meeting the demands of the ever increasing number of patients seeking immediate treatment and are resorting to HIS as a solution (Costa, de Oliveira & de Oliveira Machado 2004; Marino 2002; Zailani & Zalazilah 2006). The uniqueness of the Alpha Hospital is that it is unlike any other hospital that has limited financial resources and it seeks ways to strategically charge the extra dollar to the patient’s medical bill or insurance. The Alpha Hospital, being under the government’s ministry, is not in the position of looking at the revenue generated by the hospital as their main source of funding. The funds are allocated as a 5 year strategic plan and the Health Ministry has the responsibility of proposing to the Ministry of Finance ways of allocating specific amounts to hospital expenditure, which includes the acquisition, deployment and maintenance of the HIS. It is widely known that the implementation and maintenance of the HIS is likely to incur expensive investment, however proper and efficient planning throughout the assimilation stages could result to substantial savings in the future (Anderson et al. 2006; Bernstein, McCreless & Côté 2007; Goldzweig et al. 2009; Øvretveit et al. 2007).

The literature review in chapter 2 did not address any issues relating to procurement being of any significance to HIS assimilation. There have been various accounts of reported literature on the proper selection of IT vendors, multiple IT vendors developing various medical applications and the criticality of IT vendor technical support (Poon et al. 2004; Wadhwa & Ravindran 2007). The specific focus on the procurement process within a healthcare facility assimilating HIS is therefore very limited. The context of this research is in a healthcare facility of a developing country and the development of the HIS for the Alpha Hospital is at a time when the rapid expansion of the IT vendor community developing various clinical applications is widely recognised. However, the acquisition of these clinical applications is not necessarily affordable by some healthcare facilities, especially those of developing countries.
According to the Malaysian government’s policy, the procurement process for organisations under the government’s administration will not have the direct involvement of international vendors in the tendering process of procurement projects (Malaysia 2010). Hence, there must be an existence of local companies in partnership with international vendors to participate in the tendering process of obtaining projects involving government facilities. Procurement processes of this type are seen as a way to assist local companies in business and fair distribution of wealth (Ibrahim 2009). Nevertheless, these advantages are constantly being abused through corruption and the distributions of projects sees unfair favouritism given to specific groups of people with political influence (Ibrahim 2009; Othman et al. 2010). As per the interview with one of the clinician’s regarding this matter:

“Don't get the politician involved, that’s number one, because you can select the best (vendor) and the best does not mean the most expensive.”

[SD17, Clinical]

The procurement process for a public healthcare facility involving people’s lives should strive to always provide a fair and transparent process. As stated in subsection 4.5.7 of chapter 4, there should be transparency in the selection of IT vendors, regardless of them being local or international companies, where selection should be based on the IT vendor’s knowledge and capability of delivering high quality medical systems, and to be able to provide the best after sale service and IT technical support.

5.3.1 Implications and Recommendations for Practice

The Alpha Hospital aspires to achieve a high level of effectiveness in the delivery of healthcare service through the assimilation of the HIS. Hence, it is crucial for the Alpha Hospital to take immediate action to ensure that the core capability of the hospital to achieve such effectiveness is developed. First and foremost, it is critical that the Alpha Hospital develops a proper IT governance structure. The daily operations of the IT department can no longer rely on directions from the clinical IT coordinator and solving issues on an ad-hoc basis. In ensuring the effectiveness of the IT services provided, the responsibilities between the IT department, users and senior management has to be carefully discussed and decided at the Ministry level. Decisions have to be made formalizing the roles and responsibilities that must be carried out by different people in
various departments across the hospital pertaining to clinical IS/IT assimilation. The Alpha Hospital should start looking into adopting widely accepted IT service management best practices and an IT governance framework, such as Information Technology Infrastructure Library (ITIL) and The Control Objectives for Information and related Technology\(^2\) (COBIT). These widely accepted frameworks provide sets of guidelines for organisations to follow in delivering IT services or establishing a proper IT governance structure. However, it may not be entirely suitable to solve the IS/IT issues within the Alpha Hospital, especially when there are limited studies done on the effectiveness of the ITIL and COBIT frameworks in a healthcare context (Lapao 2011; Ozkan, Byakal & Sincan 2008). Nevertheless, it may serve as a guide for the Alpha Hospital to redesign the IS/IT principles, processes and departmental structures.

The need for strong clinical governance is especially crucial in promoting and sustaining the use of the HIS across all levels of healthcare staff. In successfully assimilating the HIS, it is imperative for the clinical governance of the Alpha Hospital to align the medical workflow and practices with IS/IT requirements. There should be a clear and transparent process of determining IS/IT budget and categorising the budget according to IS/IT necessities of critical medical departments.

In view of the critical nature of providing excellent healthcare services to the public, the selection of the most appropriate IS/IT applications to assist clinicians in performing their duties is an important decision. It may not be the accepted cultural practice in the public services of Malaysia, however, it is important that the hospital’s senior management, including the HIS champion and his team, makes a proposal to the relevant Ministries

\(^2\) “COBIT is an IT governance framework which allows managers to bridge the gap between control requirements, technical issues and business risks” (ISACA 2011). COBIT aims to provide a clear policy development and good practice for IT control throughout organizations, which emphasizes on regulatory compliance, to help organisations increase the value attained from IT thus enables alignment (ISACA 2011)
that changes to the procurement process involving IS/IT projects in public hospitals be made. Due to the sensitivity of the procurement issue, the senior management of the Alpha Hospital should try to negotiate with the Health Ministry to allow procurement processes involving IS/IT projects in public health facilities to be decided by independent bodies, such as medical NGOs or, if necessary the Royal Council. The importance of IT vendor selection to provide information systems to public hospitals must be highlighted. The selected IT vendors are highly responsible in maintaining the HIS to support the hospital’s daily operation in providing high level healthcare to the population of Malaysia.

5.4 The Technology Context

Within the technology context, the IS/IT infrastructure, system design, performance and integration were elements found to be critical in ensuring success of HIS assimilation.

Table 16 Technology Context

<table>
<thead>
<tr>
<th>Theme</th>
<th>As per conceptual model</th>
<th>Consistency with theory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health IS/IT Infrastructure</td>
<td>IS/IT Infrastructure</td>
<td>Robust, innovative and modern health IT infrastructure is essential in promoting HIS diffusion amongst health professionals (Van Der Weyden 2009)</td>
</tr>
<tr>
<td>Software &amp; Hardware Technology Readiness</td>
<td>Technology Readiness</td>
<td>Technological readiness involves infrastructure, relevant systems, hardware and technical expertise which is considered important factors for successful IS/IT adoption (Armstrong &amp; Sambamurthy 1999; Kwon &amp; Zmud 1987).</td>
</tr>
<tr>
<td>System Design and Performance</td>
<td>-</td>
<td>Healthcare applications has to be designed to meet the needs and priorities of the end users (Damberg et al. 2009)</td>
</tr>
<tr>
<td>Integration</td>
<td>-</td>
<td>Since the mid 80's there were challenges when hospitals try to integrate data to allow interoperability and communication among different systems (Wager, Lee &amp; Glaser 2005)</td>
</tr>
</tbody>
</table>

The concept of technology readiness, as described by Snyder-Halpern (2001), refers to the ability of the healthcare organisation’s existing hardware and software to support the technology innovation adopted by that organisation. The healthcare IS/IT infrastructure has been described in the previous section as supporting the theoretical concept of IT infrastructure in the resource based view of the firm literature. In addition to the theoretical underpinning of the resource based view of the firm, findings of this research also support the claim of Van Der Weyden (2009) that a robust, innovative and modern
health IT infrastructure is essential in promoting HIS diffusion amongst health professionals.

With regard to integration, clinicians are in need of expedient information access and retrieval of medical history in order to provide the right diagnosis to referred patients. This ignites the need for integration between departments within the Alpha Hospital, and with other public hospitals around the country in expediting the process of patient diagnosis. As highlighted by many clinicians of the Alpha Hospital, integration is essential. Below are some of the responses:

“If we could remotely log in to the system here from anywhere around especially when I have clinics outside Kuala Lumpur…. in the future if they have enough money and convert all hospitals with HIS to talk to each other, because I know of other hospitals which also has HIS but we are not talking to each other….. it would be ideal if the system talks to each other”

[SD1, Clinical]

“For success, the keyword is integration…i can update data on my side and if the other hospitals want to see the updates, we can be linked and it would be better...”

[SD2, Clinical]

“...there are close to 18 IT hospitals, and these 18 hospitals don't talk to each other...”

[SD3, Clinical]

The issue of HIS integration has been reported in the literature for decades and is unfortunately still among the core issues in HIS success that remain relevant yet unsolved (Haux 2006; Kuhn & Giuse 2001). Due to existence of multiple IT vendors developing numerous applications for different medical departments and hospitals, there exists challenges when hospitals try to integrate data to allow interoperability and communication among different IT systems (Wager, Lee & Glaser 2005). Integration of medical records between local and regional hospitals has been argued to be of significant importance in creating a complete HIS and in providing significant benefits to clinicians who are in need of inter-department collaboration in solving patient’s cases (Anderson, et al. 2006; Ishikawa et al. 2007; Otieno et al. 2008). In ensuring success in IT systems integration organisations require substantial human, financial and technology resources,
Discussion

however the scarcity, poor maintenance or weak political commitments to these resources is exceptionally common to developing countries and this causes information systems projects to fail significantly (Avgerou 2008). In support of this argument, Bulgiba (2004) suggests that there is a need for a coordinating body that acts as a point of reference where all IT vendors and technology implementers have to refer to the standards of technology implementation. This would then lead to data and system synchronization in order to provide a platform for the improvement for future HIS integration.

The need for an improved HIS design and improved performance is crucial for the medical staff of the Alpha Hospital. As a result of poor maintenance and the lack of financial support, HIS users at the Alpha Hospital had to endure numerous system downtimes and slow processing whilst using the HIS. These two issues were commonly discussed amongst interviewees including clinicians from critical departments such as paediatrics, obstetrics and gynaecology, emergency, the pathology laboratory and radiology. The deficiency in the performance of the HIS is especially intolerable to the pathology and radiology departments when there are blood tests, scan and x-ray requests to be attended to on a 5 minute average response time from various clinical departments. Based on previous literature and the theory on users acceptance of IS/IT, expecting good performance in a system is well recognised as an ultimate predictor of the user’s intention to use the system (Davis, Bagozzi & Warshaw 1992; Taylor & Todd 1995; Venkatesh & Davis 2000; Venkatesh et al. 2003). In support of user acceptance theory, various other healthcare IS/IT research has concluded that expecting good performance is deemed important in deciding to accept technology and may provide an influence either directly or indirectly towards the behavioural intention of the user. This would then lead to determining the user’s attitude towards the healthcare system (Chau & Hu 2002; Chismar & Wiley-Patton 2003; Hu et al. 1999; Jayasuriya, R 1998; Schaper & Pervan 2007). This has supported the case of users at the Alpha Hospital where being obligated to use an HIS that did not provide an acceptable level of performance also caused considerable frustration and delays in the daily routine of work activities. Therefore, the role of a good HIS system design with good performance is well recognised as one of the major elements in the success of HIS assimilation.
5.4.1 Implications and Recommendations for Practice

The common issue discussed with all clinicians of the Alpha Hospital pertaining to infrastructure concerns clinical rounds in wards with wireless access. Many of the clinicians would like to eliminate the redundancy of having to write patient progress notes on paper and transfer these patient progress notes into the HIS after completing their daily ward rounds. The demand for wireless laptops with improved wireless access to allow data entry via laptop during clinical rounds was frequently mentioned during the interviews, as highlighted in sub section 4.5.1. Nevertheless, this demand has not been entirely fulfilled after 10 years. The interviews with senior management also highlighted that there was little that can be done in the case of wireless access and it is understood that it was causing frustration amongst clinicians. In view of this, the clinical Head of Department has to play a vital role in continuously highlighting to the senior management the need to improve the current ward condition. In constantly highlighting this situation to the senior management, the issue can be escalated further to the Health Ministry. It is also highly recommended that a Ministry representative should be assigned to each medical ward to assess and evaluate the predicaments of the medical staff.

IT infrastructure reports should also be the responsibility of the IT department manager who should frequently provide assessment reports on the quantity and quality of hardware in use across the entire hospital. An inventory should be kept at all times detailing the hardware items specifications, physical location, their virtual location (IP addresses), their life-history including commission date, faults discovered or complaints received and services performed. Should one or more of the items begin to deteriorate in providing services, these items should immediately be assessed and the results of assessment must be escalated to the relevant group involved in rectifying the problem. Maintenance of the hardware and software at the Alpha Hospital is outsourced to an outside IT vendor. It is the responsibility of the internal IT department staff to ensure that IT vendors conduct both preventive maintenance services and corrective maintenance services. These maintenance services are scheduled at regular intervals and based on registered complaints or an awareness of problems. With proper scheduled maintenance, problems with insufficient and faulty wireless access may be reduced as these maintenance activities ensure that equipment is always in good working order.
With the issue of missing data, the IT department and maintenance IT vendor should work closely in planning for a more structured approach in data backup and recovery. An offsite backup facility, especially for medical data, should be proposed to the Ministry to ensure that any loss of data due to a system fault or natural disaster can be recovered quickly. There should also be proper planning for IS/IT systems and network upgrades, software patching and system customization to ensure that delay in accessing data and application downtime is minimised.

There is a vast array of medical specialisation in different departments of the hospital, and there may be different requirements in the use of the HIS. Nevertheless, in the context of the use of the HIS by all the clinicians in various departments of the Alpha Hospital, it is not necessary to develop separate information systems for the various departments, and the addition of new departments does not require additional systems. To ensure the necessary flexibility, the HIS has to be designed in such a way that it provides adaptability in the expansion of datasets to cater for the extra needs of the service, or the omission of some data elements that are not relevant to the particular department. These adaptabilities are commonly requested by some of the clinicians at the Alpha Hospital, especially when they find that the data and forms displayed do not cater for the needs of their specialty. Through analysis of the interviews with clinicians from psychology, gynaecology and micro-surgery, it is apparent that these three departments have separate requirements that the HIS failed to meet.

The psychology department was more interested in contacting patients through the HIS, and the efficiency in data mining for patient histories is a top priority for clinicians within this department. The hand and micro-surgery clinicians however, made very minimal use of the HIS. They are more interested in activities that are occurring in the operating theatre, especially involving specialists monitoring and providing guidance remotely on a surgical procedure that is currently being performed by a surgical assistant. As a result of their requirements for the HIS, another web application was developed internally by the hand and micro surgery department to have video monitoring on surgical procedures conducted in the Alpha Hospital’s operation theatres. Through this web application, the Head of Department is able to monitor activities within his department, and provide guidance remotely from anywhere around the world. The gynaecology department
receives one of the highest numbers of patients daily for the Alpha Hospital. The HIS requirement for this department is mostly on statistical reports on the number of male or female babies delivered per month and also records the mother’s age, race and health status. However, as highlighted strongly by SD3, the HIS failed to produce statistical reports as per this requirement

“With IT, statistics should be like a breeze isn't it? Unfortunately I don’t know maybe the government have no money to buy the software for that purpose, by right all these information is in the system isn't it?so, why can’t I get simple things like how many Malays, Indian, Chinese, under 18 , above 25, but it's not there.”

[SD3, Clinical]

Frequent feedback sessions or user requirement meetings, performed between the IT vendor, IT department and clinical representatives in order to achieve consensus among clinicians on data fields, nomenclature and structure of the required data entry forms and display, and would be most beneficial to the development of the HIS at the Alpha Hospital.

5.5 The Environment Context

Analysis of the environment context revealed significant facilitators to the success of HIS assimilation involving stability of the organisational political structure, public hospital work culture, government regulation and organisational leadership. The political influence in the healthcare industry in Malaysia is very much dominant to any of its other government Ministries and agencies. The criticisms directed at the public sector, which includes public hospitals, have always been about the hospital’s inefficiencies, red tape, lack of flexibility, ineffective accountability and poor performance (Siddiquee 2006).

Various reform plans have been outlined, and with the ambition of being competitive in the context of globalization, there was a need to redesign governmental processes in order to provide service excellence (Siddiquee 2010). Nevertheless, having been in a legacy system for over 5 decades, changes in government processes pertaining to civil servants, are very difficult to accomplish. This applies similarly to the healthcare industry of Malaysia. Although the government has launched the vision 2020 strategic plan which incorporates IS/IT as the backbone of all initiatives including healthcare reform, the
actual implementation of these plans and projects is not as flourishing as how it was intended (Yow 2010).

The political influence at every stage of the assimilation process for the HIS is evident and causes many obstacles for the success of the HIS assimilation. Some of the strongest comments on political influences into HIS assimilation projects were:

“You have to understand Malaysia. Malaysia has a lot of political influence... it's very sad when you know we are controlled by one organisation but very fragmented...the Health Ministry should organize it better, take control of it....The Ministry of Health like many of our other ministries there's a lot of "wahyu"...it's difficult....difficult...”

[SD17, Clinical]

"...problem is that we have to submit our request, justify it and all that, then various level of government would have to say if it's okay, then finally the Finance ministry will give us the money. Then only we can do things, so quite often when you want something now you will get it one year or a year and a half later or two years later. And sometimes when you ask for certain amount you may only get half of it...."

[Mr. C, Clinical & IT]

Research scholars have noted that organisational politics provide an increasing effect on organisational IS/IT implementation (Eisenhardt, K M. & Zbaracki 1992; Fehse, Krabbendam & Boer 2002; Pfeiffer 1982; Shortliffe 2005). The opportunities of investing in good HIS applications has been argued to be at risk if politics has meddled with the process of deploying the IS/IT in a healthcare facility (Johnson, CW 2009).

In the case of the Alpha Hospital, the political issues are highly sensitive, thus generally not discussed. Nevertheless, senior clinicians who were involved with the HIS project,

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3 This term is in the Malay language. A direct translation for “wahyu” is revelation from God to His Prophets. However, this term was used by the respondents to explain how unnecessary IS/IT equipment and new processes are being directed by the Ministry which must be accepted by the people in the public service without discussion or resistance. The term “wahyu” in this context is usually described by the local Malaysians as something that comes with political influence and the new “unexpected” or “unrequested” items that is brought into the organization is usually of an interest to the political member’s business counterparts and not of the people in the organization.
have implied that the current political behaviour is representative of cultural norms where it is publically known, but silently exposed. In the context of providing healthcare services, activities involving groups of people trying to attain their personal gain with powerful political influences in order to grasp benefits solely for individual satisfaction and greed must be avoided. Creating an upfront agreement, negotiating directly with higher management and providing inducements in order to obtain contracts should not be accepted as part of organisational practice. There is an essential need for a leader who promotes accountability, transparency and upholds strong ethical values in realizing the objective of providing better health and quality of service to the people.

There should also be freedom in practicing rights and liberties as well as demanding transparency in the Ministry’s policies in order to promote better technology assimilation plans and activities. This is an obligation on the Ministry to provide better healthcare services to the public, especially when the tax payer’s money is being used to subsidize public healthcare expenditure, which includes IS/IT initiatives (Chee & Barraclough 2007).

### Table 17  Environment Context

<table>
<thead>
<tr>
<th>Theme</th>
<th>As per Conceptual Model</th>
<th>Consistency with theory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Political</td>
<td>-</td>
<td>Politics can be seen as an unavoidable feature in organisational life in general (Eisenhardt, K M. &amp; Zbaracki 1992; Fehse, Krabbendam &amp; Boer 2002; Pfeffer 1982) The opportunities of investing in good HIS investment is anticipated to be hazardous and wasted if politics is meddled with patient safety (Johnson, CVW 2009)</td>
</tr>
<tr>
<td>Public Hospital Work Culture</td>
<td>-</td>
<td>Government hospitals still hold a very highly regulated civil service culture that led to the inefficiency of services (Chee &amp; Barraclough 2007) Towards achieving organisational goals and success there is a dire need for dramatic changes in culture, relationships and skills amongst hospital staff to transform the hospital culture from a rigid and multi-level hierarchy into a more flexible and collaborative work environment (Bate 2000)</td>
</tr>
<tr>
<td>Government Regulation</td>
<td>Regulation</td>
<td>Government’s health policy and regulation has been known to influence the adoption of healthcare technology as highlighted by Chang et al. (2007) and Chee &amp; Barraclough (2007)</td>
</tr>
<tr>
<td>Leadership</td>
<td></td>
<td>The medical profession requires leaders armed with a vision in providing a better future, courage to take risks, confidence to withstand criticism and energy to continue with the tireless efforts of change (Cohen 1998)</td>
</tr>
</tbody>
</table>
Public services work culture dictates that submissive behaviour is the usual practice, and this may have been proven to work in terms of fully utilizing the HIS at the Alpha Hospital. However, freedom to express one’s opinion for the benefit of the patient’s well-being through the use of the HIS should be heard, considered and transformed into actions. The submissive work culture in the Alpha Hospital was discussed by some clinicians and non-clinical staff to portray both positive and negative impact:

“when we started here long time ago, all the core group including the head of department is here, so whether you like it or not the lower rank has to follow and use it”

[MD2, Management]

“When there is a problem and if we complain then that starts the blame game. We blame the IT department for not giving the right application; the IT department blames us for not using it right…”

[SD12, Clinical]

“….. we say we want people to innovate and all that, well it doesn't happen”

[Mr. C, Clinical & IT]

The findings of this study on work culture support the claim of Chee & Barraclough (2007) and Bate (2007), who found that government hospitals still adhere to a very highly regulated civil service culture. It has been contended that this civil service culture has led to inefficiency of many public services. Therefore, to assist in achieving organisational goals and success, there is a need for dramatic changes in work culture, relationships and skills amongst hospital staff in order to transform the hospital from a rigid and multi-level hierarchical culture to a more flexible and collaborative work environment.

With respect to change, there is also a need for strong leadership among senior clinicians possessing the ability to merge managerial and IS/IT skills to assimilate the HIS in computerized hospitals. Management support was discussed during the interview with the IT staff:

“the management support is very important….our needs for the budget and infrastructure, for maintenance and why we need downtime. So, the problem is when they...
don't understand, if they do it would be easier for us. We can see the difference when we had the previous Medical Director who was someone that has been in this hospital for long time, so to deal with the Medical Director in these issues was easier, and we gained support."

[IT5, IT Department]

In the literature review, a managerial obstacle was defined as that part of the elements under the environment context that influence the success of technology assimilation. However, managerial obstacle as described by Roberts et al. (2003) is the management’s ability to have managerial skills and efficiency in handling change management on the subject of technology adoption and adaptation. Leadership was not mentioned explicitly but implied through the literature pertaining to managerial obstacles. Leadership skills are considered an important contributor to the success of innovation assimilation, as the success of assimilation will not only rely on the innovation itself, but also on the behaviour of the adopters and by the strength and support provided by the management (Attewell 1992; Greenhalgh, Robert & Bate 2008; Yetton, Sharma & Southon 1999; Zmud, Robert W 1984). Hence, this research argues that in healthcare context leadership ability and the efficiency of the management in handling change could determine the effectiveness of the innovation assimilation and thus lead to sustained use of the HIS.

5.5.1 Implications and Recommendations for Practice

Education and awareness are the keys to ensuring that the elements of the environment context facilitate the success of HIS assimilation. In terms of the political element, although it seems that it is beyond the control of the healthcare organisation, people must be educated so that they are rightfully responsible in choosing the right political candidate who will be involved in decisions that could change policies and regulations. Eliminating corruption and upholding transparency, especially in project tendering and financial distribution, is the essence of good leadership particularly in resolving many issues regarding HIS assimilation. It is also imperative that the four telehealth or e-health initiatives, which were initially introduced, by the government are revisited and assessed on the success of their respective implementations. Where necessary, the government has to provide new policy and regulation in compliance with the technological needs of current medical practice. There is also a need for internal monitoring and evaluation of
the effectiveness of HIS. This is to determine the contribution of the HIS towards efficiency of healthcare delivery.

The work culture in the Alpha Hospital has to be tailored towards a more transparent workflow to provide a more concise and truthful feedback on the current performance of the HIS. The fear of jeopardizing one’s position when expressing dissatisfaction towards the HIS has to be eliminated and senior management must also promote such openness regardless of ranking and position. The senior management has to provide a medium for communication for staff to channel their views and opinions without having to feel intimidated by their position in the hospital. These opinions must then be acted upon by the senior management to ensure that there is a sense of being appreciated and involved with the organisation and that each individual plays an important role in organisation’s decision making.

5.6 HIS Assimilation Barriers

Analysis of interview transcripts identified several barriers to HIS assimilation, which can be categorized as being either global or local. Global barriers appear throughout all the assimilation stages and high level management involvement is required to overcome these barriers, while local barriers are those that occur at specific stages of the assimilation and may be resolved by specific groups or members of the organisation.

In the case of the Alpha Hospital, findings indicate that an assimilation gap does exist in the deployment of the HIS. This is evident through the analysis that the HIS was acquired rapidly and implemented by a “big bang” approach, but was not deployed across the entire hospital population as swiftly and smoothly as expected. The focus on the assimilation gap for the Alpha Hospital supports the theory of diffusion modelling, that from a practical perspective the larger portion of the hospital’s population is greatly affected by this gap and that technology appears to be successfully based solely on the idea of having a new innovation acquired in the organisation but nevertheless failed to be deployed (Fichman & Kemerer 1999).
In obtaining a more in depth and supportive explanation, Table 18 exhibits the barriers that the healthcare organisation has to overcome globally and locally in each of the assimilation stages. Among all the barriers identified through the data analysis and findings, overcoming financial difficulties, political influences and lack of up-to-date knowledge on healthcare technology and systems were the three most common barriers involving all stages of assimilation. Hence, these barriers were categorized as global barriers.

In relation to the financial barrier, the financial investment in HIS will not only incur continuous increases in value but also become a rising issue in many healthcare organisations in future (Bernstein, McCreless & Côté 2007).

Table 18  Barriers to HIS Assimilation

<table>
<thead>
<tr>
<th>Barriers</th>
<th>Type</th>
<th>Assimilation stage involved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financial</td>
<td>Global</td>
<td>All</td>
</tr>
<tr>
<td>Political</td>
<td>Global</td>
<td>All</td>
</tr>
<tr>
<td>Keeping up with medical technology</td>
<td>Global</td>
<td>All</td>
</tr>
<tr>
<td>Lack of IS/IT knowledge</td>
<td>Local</td>
<td>Initiation</td>
</tr>
<tr>
<td>Lack of Leadership</td>
<td>Local</td>
<td>Initiation</td>
</tr>
<tr>
<td>Lack of proper planning</td>
<td>Local</td>
<td>Initiation</td>
</tr>
<tr>
<td>Clinicians buy in process</td>
<td>Local</td>
<td>Adoption</td>
</tr>
<tr>
<td>Maintenance</td>
<td>Local</td>
<td>Adoption</td>
</tr>
<tr>
<td>Sustaining the role of clinical and IT experts</td>
<td>Local</td>
<td>Adoption</td>
</tr>
<tr>
<td>Efficiency of vendor support</td>
<td>Local</td>
<td>Adoption</td>
</tr>
<tr>
<td>Thorough testing</td>
<td>Local</td>
<td>Adoption</td>
</tr>
<tr>
<td>Communication among staff</td>
<td>Local</td>
<td>Adoption</td>
</tr>
<tr>
<td>Sophisticated IS/IT infrastructure</td>
<td>Local</td>
<td>Adoption</td>
</tr>
<tr>
<td>Clinical &amp; IT Governance</td>
<td>Local</td>
<td>Routinization</td>
</tr>
<tr>
<td>Proactive communication</td>
<td>Local</td>
<td>Routinization</td>
</tr>
<tr>
<td>24X7 technical support</td>
<td>Local</td>
<td>Routinization</td>
</tr>
</tbody>
</table>

Public hospitals are faced with the challenges of improving service quality and meeting the demands of the ever increasing number of patients seeking immediate treatment, while resorting to the HIS as a solution (Costa, de Oliveira & de Oliveira Machado 2004; Marino 2002; Zailani & Zalazilah 2006). It is widely known that the implementation and maintenance of HIS is likely to incur expensive investment, however, proper and efficient planning throughout the assimilation stages could result in substantial savings in the
The political barrier in many of the government organisations leads to complications in many parts of the organisation’s work processes. It requires change in work culture, good governance and a high degree of political and administrative commitment by the top government authorities. There is a need for a more transparent way of managing the current business practices in IT vendor selection and procurement processes. Although it may be inevitable to have political pressures and influences present in government organisations, since public hospitals are not required to generate revenue from the patients, there should be an exception for the hospital administration to be independent in making decisions for the hospital in order to cater for patient’s healthcare and wellbeing.

Finally, in assimilating HIS, the importance of having to overcome barriers pertaining to the lack of knowledge about systems, latest advancement in medical technology and an understanding of clinical procedures is highly required among clinicians in order to achieve the aims of providing successful end-to-end hospital IS/IT.

5.7 HIS Assimilation Barriers at the Initiation Stage

Initiating the acquisition of a HIS is a major process for a healthcare organisation and requires thorough planning and effective management. The identification of a new IS/IT innovation that is viable to the healthcare organisation is the first step in an assimilation process to support and enhance the organisation’s operations (Agarwal, Tanniru & Wilemon 1997). Table 19 describes the barriers involved in the initiation stage and relationship of the identified barriers to the healthcare IS/IT theories and literature.

Table 19  Initiation Barriers

<table>
<thead>
<tr>
<th>Assimilation Stage</th>
<th>Barriers</th>
<th>Consistency with theory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initiation</td>
<td>Lack of IS/IT knowledge</td>
<td>The deficiency of medical expert knowledge could lead to issues with uncertainty in the new healthcare innovations, as well as users accepting and adopting the new innovation (Castillo, Martinez-Garcia &amp; Pulido 2010)</td>
</tr>
<tr>
<td></td>
<td>Lack of Leadership</td>
<td>Strong managerial and leadership roles should be present at the initial stage in order to clearly define the criteria and</td>
</tr>
</tbody>
</table>
# Discussion

<table>
<thead>
<tr>
<th>Assimilation Stage</th>
<th>Barriers</th>
<th>Consistency with theory</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lack of proper planning</td>
<td>Planning is critical especially in engaging physicians early in the planning process to minimize resistance during implementation and adoption (Damberg et al. 2009)</td>
</tr>
</tbody>
</table>

In the case of the Alpha Hospital, a methodical plan was developed by the Malaysian Ministry of Health officials 4 years before the hospital foundation was laid. Although it appears that the planning was done exhaustively through many meetings and sessions between the appointed project team, which consisted of enthusiastic clinical Heads of Departments, nurses and non-clinical members with the chosen IT vendor, there were oversights and unexpected outcomes due to unanticipated events. Upon reviewing what was then thought of as an appropriate decision, many senior clinicians feel that the lack of knowledge in the healthcare IS/IT area perhaps has caused some of the issues that are currently being encountered. Back then the senior clinicians relied heavily on IT vendor promotions, suggestions and promises that were taken literally without anticipating any consequences.

To avoid repeating these mistakes in other healthcare contexts, it was suggested by the participants and through the literature review that strong managerial and leadership roles should be present at the planning stage in order to clearly define the criteria and methods for selecting IT vendors and their products (Wager, Lee & Glaser 2005). As a result of the lack of strong managerial influences, the initiation stage for the Alpha Hospital is perceived to have been very expensive since hasty decisions were made on IS/IT infrastructure acquisition causing software and hardware incompatibility and inadequacy. The lack of planning, failure in managing IT vendors, vagueness in the request for proposal, inaccurate presumption regarding the needs of the different medical specialties and underestimating the magnitude of the project were some of the pitfalls in assimilating the HIS at the Alpha Hospital.

The lack of medical leadership especially in cultivating an open discussion is seen as a barrier that the hospital needs to overcome in order to allow a more open concept.
amongst staff. This provides a better platform for clinical and non-clinical staff to express their opinions on decisions made by the Ministry instead of just accepting orders without clear justification. Hence, there is a need for more open discussion and dialogue to resolve issues arising during the initiation stage in order to avoid compromising the consecutive stages of assimilation.

5.7.1 Implications and Recommendations for Practice at the Initiation Stage
To address the issue of a lack of IS/IT knowledge, senior clinicians who are appointed to the HIS project team have to be knowledgeable in both clinical medicine and healthcare IS/IT. The introduction of medical computer software and medical informatics courses should assist clinicians and nurses as it provides a foundation for the use of IS/IT amongst healthcare professionals (Norris & Brittain 2000). This initiative can be done at both the micro-level in the Alpha Hospital by the IT department or at the macro-level by the Malaysian Ministry of Health. Healthcare informatics courses could be introduced as a prerequisite for medical students before undergoing internship.

In planning for assimilation of the HIS, a thorough preliminary study on the existing or a similar context which may be in different industries, should be conducted to identify issues for both clinical and healthcare IS/IT. This is necessary to evaluate the infrastructure readiness, technology needs and user requirements of every medical specialization. With acquired technical knowledge on healthcare IS/IT, the IT vendor proposals and recommendations can be better managed in providing a more dynamic technical discussion during the planning stage.

The lack of leadership in supporting the HIS assimilation project at the initiation stage has to be addressed by appointing leaders who are in possession of high quality personal traits. It has been argued that a leader who has the drive, knowledge, motivation, honesty and integrity is the key factor to successfully taking the necessary actions in realizing organisational visions and objectives (Kirkpatrick & Locke 1991). In the case of the Alpha Hospital, despite the fact that the champion has displayed a charismatic personal trait in ensuring that the HIS is widely used across the entire hospital, it should not be
through the champion’s personal traits that HIS is expected to be successfully assimilated. The leadership traits should exist in each clinical department especially in those who will be appointed as a member of the HIS project committee. These traits must also be accompanied by a passion for utilizing technology for clinical benefits. Through passion and strong personal qualities, the medical professionals would be better motivated in sustaining their enthusiasm in using HIS.

5.8 HIS Assimilation Barriers at the Adoption Stage

Among the three assimilation stages, the adoption stage has been identified as the stage having the most barriers to success. It is evident through the interviews with senior clinicians that during the adoption stage the HIS is maximally challenged. This is also the stage when clinical users are tested on their ability to accept and successfully use the technology acquired (Agarwal, Tanniru & Wilemon 1997). Table 20 lists all the identified adoption barriers and the relationship of these barriers with the healthcare IS/IT literature.

Table 20 Adoption Barriers

<table>
<thead>
<tr>
<th>Assimilation Stage</th>
<th>Barriers</th>
<th>Consistency with theory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adoption</td>
<td>Clinicians buy in process</td>
<td>Clinicians “buy-in” was essential for HIS implementation to be successful (Damberg et al. 2009)</td>
</tr>
<tr>
<td></td>
<td>Maintenance</td>
<td>System maintenance is also reported as one of the barriers of HIS adoption (Goldstein &amp; Blumenthal 2008)</td>
</tr>
<tr>
<td></td>
<td>Financial</td>
<td>Ongoing costs of HIS during adoption is also considered as one of the greatest barrier to HIS adoption (Ingebritson 2007)</td>
</tr>
<tr>
<td></td>
<td>Sustaining the role of the champion having both clinical and IT expertise</td>
<td>Physician acting as champions and leaders has been shown to be a critical success factor for many successful healthcare technology implementation (Yackanicz, Kerr &amp; Levick 2010)</td>
</tr>
<tr>
<td></td>
<td>Efficiency of vendor support</td>
<td>Lack of expertise to support health IT services and many vendors are stronger on sales than on support (Detmer et al. 2008; Lorenzi et al. 2009)</td>
</tr>
<tr>
<td></td>
<td>Thorough testing</td>
<td>Thorough testing could improve the chances that the healthcare application design is integrated with existing workflow and business processes in a clear and efficient way (Corrao et al. 2010)</td>
</tr>
<tr>
<td></td>
<td>Communication among users</td>
<td>Communication among users is a very important factor contributing to the user acceptance and adoption of new healthcare application (Castillo, Martinez-Garcia &amp; Pulido 2010)</td>
</tr>
<tr>
<td></td>
<td>Sophisticated IS/IT infrastructure</td>
<td>Increasing use of sophisticated IS/IT infrastructure can lead to enormous advantage to clinical workflow (Bardach et al. 2009)</td>
</tr>
</tbody>
</table>
The Alpha Hospital has its own unique way of conducting its adoption process and the hospital was opened in 1999 solely for the purpose of testing by the medical staff. The deployment was called a “big-bang” in which the entire system for the hospital was commissioned and integrated without a single manual process left in place. Committed support from staff of the organisation is crucial at this stage, especially from the clinicians. Due to the enthusiastic group of key players ensuring the smooth transition of workflow from the previous manual processes to the HIS, committed support was sought quite promptly from the medical staff. This is evident from the interviews when the respondents claim that if it was not due to the fact that the enthusiastic key players had Heads of Clinical Departments among them; the committed support process would have been a lot slower.

In understanding the Malaysian government’s organisational submissive work culture, in which subordinates succumb to directions of their leaders, the HIS was being fully utilized regardless of the Alpha Hospital staff members’ view of the application. This method of imposing orders to subordinates is described by Fehse, Krabbendam & Boer (2002) who found that the internal political behaviour by the upper management has brought about the use of an “adapting orders” approach which serves to ensure that the system is fully tested and used by all. The “adapting orders” approach stems from the Malay culture of being a collectivist society (Hofstede 2005) where there is a need to be harmonious in any human relations, personally or in an organisation, to maintain or watch over other people’s feelings during interaction in order not to cause any discomfort or conflict (Ahmad & Abdul Majid 2010; Goddard 2002). It is also due to the cultural upbringing of many traditional Malays according to their cultural beliefs and folklores, that respecting the elders and superiors is considered as very pertinent in a person’s lifestyle (Ahmad & Abdul Majid 2010). Hence, members of the family or organisation do not speak up, or even express a contradictory point of view, in order to maintain the social harmony in every communication (Ahmad & Abdul Majid 2010; Beamer & Varner 2008).
By following the orders of using the HIS, this may be observed as unfair to the hospital staff, however the decision was made as the leaders understood the non-contradicting attitude of their subordinates and apparently the “adapting orders” technique did work in promoting the use of HIS amongst all staff especially clinicians. It is due to this “force” that the users are actually adapting well to the HIS. Hence, adoption was perceived by senior management as a non-issue. Success in adopting the HIS was apparently greater for the Alpha Hospital when the use of the system was based on autocratic directions.

The Clinical IT coordinator was known to be the champion of the entire HIS assimilation project and a person who has a thorough knowledge on both IS/IT and clinical medicine. A major barrier at this stage was maintaining the positions of the clinical IS/IT experts, which includes the clinical IT coordinator who had to serve as a clinician and simultaneously oversee the IS/IT activities throughout the hospital. There were also the positions of IT nurses who had strong IS/IT knowledge and were assigned to assist the clinical IT coordinator as application specialists. The IT nurses also act as the bridging communicator in collecting feedback and change requests from the HIS users. The IT nurses were involved with training new clinicians and other new hospital staff to use the HIS to carry out their duties.

With the growing enthusiasm among all the staff in having considerable assistance from the HIS to facilitate their work processes, as compared to working with manual processes, the increased efficiency of the Alpha Hospital was undeniably beneficial to the patients. With an unexpected increase in the number of patients, the processing capability of the HIS was challenged. As a result, after three years of being a favourite of the organisation, the HIS began to fail in its ability to meet demand. Servers were crashing, processes were back logged and applications were hanging. Delays and shut downs were a common scenario for every department as the system was highly utilized but unable to cope with the volume of data. It was under these circumstances that emotions were tested and experienced clinicians were starting to have second thoughts about supporting the end-to-end computerization concept and began pressuring the upper management to resort back to manual processing. The IT vendors were being asked for a major upgrade and
maintenance, and unfortunately some applications were no longer able to resume services. Due to the inadequacy of hardware and the barriers to obtaining more financial resources, difficult decisions had to be made to terminate the services of some HIS modules. It was then that the lack of performance of the HIS was analysed and it was found that the methodology of having a “big-bang” deployment method was indeed unsuitable.

Other non-system related barriers at this stage for the Alpha Hospital involved the inefficiency of the local IT vendor managing the maintenance project. The frequent change of local IT vendors, the mismanagement of system documentation and political influence in the procurement process of the IT maintenance contract were some of the major hurdles that compromised the improvement of the HIS. It took a few years for the non-system related issue to resolve and finally the HIS was scheduled for an upgrade. Improvements to the HIS from the upgrade were tolerable but not very satisfying. As duty calls and patients need to be treated, the medical staff of the Alpha Hospital tolerated the delays and minor issues as long as they could perform their daily routine. Some clinicians found ways to manipulate the system to use it more efficiently, however some just coped with the system with their own patience and reasonable actions.

There are a number of standard processes in implementing a new information system for a healthcare organisation, as highlighted by Wager, Lee and Glaser (2005). The Alpha Hospital has followed a few of these standard procedures in the implementation of the HIS where it has installed and configure the system, undertaken staff training and ensured that ongoing training was in place, and data transfer and data conversion was successful. However, the analysis of workflow processes was overlooked and preparation to perform any necessary process reengineering was not in place. Many clinicians admitted that the test of the HIS updates were not very thorough and was inadequate. Communication relating to the projects progress was not circulated well amongst clinicians and the IS/IT infrastructure was insufficient to ensure minimal downtime and adequate response time. This is commented on by some of the participants:
“There should also be proper testing. Like right now, there is not enough testing than they just launch it so that creates problem.”

[SD1, Clinical]

“I feel the testing is too short, you test a little while then you go live...the complexity of patients can’t be seen in a short while...Perhaps they should have given us some time maybe about 3 months for testing.”

[SD2, Clinical]

The communications amongst staff with regards to the HIS during the adoption stage were mainly carried out between the IT department staff and the appointed IT vendors for the project. Clinicians were relatively unsatisfied with the way communication was being handled with regard to the project as numerous unexpected incidents took place without prior warning or reminders. The clinicians felt that there were some communication failures between users and maintainers of the applications. The excerpt from the interview below clearly states that there should be an improvement in ways that information is communicated in the Alpha Hospital to avoid misunderstanding and disappointment when trying to adopt the HIS.

“I think everyone must be aware whether the program is there or not there, no point telling the whole hospital it’s there but when it is required the people who are supposed to do it do not know about it. I think besides implementing to the end users, the person that is dealing with all this need to know that there is such a service being provided, otherwise there will be ongoing conflict where the end users are informed that there is such service and it can be done but the person implementing it does not know that the service has started.”

[SD1, Clinical]

Finally, the need for a sophisticated IS/IT infrastructure at this stage is crucial as IS/IT infrastructure is regarded as a strategic option in which organisations in possession of this sophistication are regarded as having obtained greater organisational advantage (Armstrong & Sambamurthy 1999). This would allow the creation of superior products and services which in turn increases IS/IT assimilation (Armstrong & Sambamurthy 1999; Liu et al. 2009; Wu, Chen & Sambamurthy 2008). The use of sophisticated
healthcare information technology systems would provide greater availability of clinical information and further enhance clinical workflow (Bardach et al. 2009). With increasing use of advanced sophisticated IS/IT infrastructure, the main objective of the Alpha Hospital in eliminating paper-based processes and charting could be achieved.

It can be concluded that the adoption stage still requires a significant amount of planning and preparation (Wager, Lee & Glaser 2005) especially in a healthcare facility that provides the first hospital end-to-end IS/IT services. With high expectations from patients seeking treatment and expecting the availability of advanced technology equipment and computerized processes, a more structured and methodical planning for IS/IT work processes is essential.

5.8.1 Implications and Recommendations for Practice at the Adoption Stage

The maintenance and financial barriers are inter-dependent with one another. With appropriate financial capabilities, the maintenance issues could have been solved. Many clinicians felt that the deployment should have taken place in a more modular manner in which it would have started on a smaller scale - perhaps evolving from one department to another and finally to the entire hospital. It is important to note that the modular manner of deployment and integration may have led to a substantial cost increase when carried out across the different departments. Considering the current situation at the Alpha Hospital, it is recommended that the IT department staff and appointed IT vendors initiate a plan for implementing a thin client network where the main processing load of the applications is undertaken by the system servers and is not heavily placed on the machines that are being utilized daily by staff in the clinics and wards.

In order to overcome the financial and maintenance barriers simultaneously, a proposal on financing a robust high end server that would be able to cater for real time 24 hours a day, 7 days a week transaction processing should be presented to the Malaysian Ministry of Health. Given the importance of this subject, the decision makers at the Ministry level should constantly be reminded in order to obtain their attention towards the improvisation of the HIS. One of the comments from the senior clinician who was part of the initial HIS
The design of the current HIS was based on the airline’s processes. Clearly the criticality and complexity of the healthcare industry was underestimated. The intensity of the data processing in the healthcare industry perhaps would have been better elucidated if the comparison was made with a similar industry, such as the telecommunication industry. The telecommunication service providers have been known for being key players in the technology innovation field (Koutsopoulou, Kaloxyllos & Alonistioti 2002; Lazar 1997). With the number of telephone calls made every single second, the billing system and network management system of the telecommunication service provider caters for millions of subscribers (Chen, Jan & Chen 2005; Ou, Hwang & Jan 2007). Telecommunications companies utilize high end servers equipped with efficient software to make sure that every calls details and network performance data are being captured. For future upgrading of projects, the Alpha Hospital could learn from a leading local telecommunication company regarding the technical architecture and maintenance process of their billing systems. It can be argued that the use of IS/IT in the healthcare industry is now as critical as other information intensive industry in the technology arena.

In the case of the Alpha Hospital, the financial barriers to assimilating the HIS are derived from the funding policies of the Malaysian government. The HIS should now be an integral part of the public hospital’s healthcare delivery system to ensure that the public receives excellent medical treatment accompanied by the advancement of technology.

The current funding for healthcare IS/IT in Malaysia is based on a per “program” basis. Each new system request, upgrade and maintenance for the HIS is considered as a separate program or project. However, separating these requests as different projects will
not favour the success of assimilating the HIS throughout the hospital as it is not practical to perceive the project in a granular manner. The allocation of a budget for any phase of the HIS assimilation should be funded by a dedicated budget that covers all areas including maintenance and post-implementation necessities of the HIS. The funding method on a project basis based on needs and priorities is no longer viable as every element at every stage of the HIS is a priority for every clinical department in the hospital.

Sustaining the role of clinical IS/IT experts and application specialists as part of the IT department is important and these staff should be recognized as permanently placed in the Alpha Hospital. The specific role of these positions is essential in assessing system functionality, identifying and preventing potential problems with the HIS applications and troubleshooting of escalated problems logged by the technical support team. The clinical IS/IT experts and application specialists may have previously been doctors, nurses or medical assistants in clinical departments. However, due to their IS/IT knowledge and capabilities, these experienced clinical staff are able to provide benefits to both medical and the IT department in relaying issues and providing solutions to the problems pertaining to clinical processes and the IS/IT systems.

The clinical IS/IT experts and application specialists should also be responsible in monitoring the overall activities assigned to the outsourcing IT vendors who provide maintenance for the HIS. It is imperative that the clinical IS/IT experts be given the authority to review the work procedure manuals of the appointed IT vendors, especially in determining the key performance indicators and service level agreements. This is to ensure that a reliable administration of the HIS is in place at all times, targeting a minimum of 99.9% system uptime every month.

During the adoption stage, it is essential that all activities are carried out as planned and be publicized frequently through an effective communications mechanism. This is to ensure that all the relevant members of organisation pertaining to the HIS assimilation project will have adequate facilities to communicate and coordinate the project activities
and report progress. This will also allow users to be informed with the projects progress and to receive regular updates on the HIS. The communication mechanism could be both formal and informal and include minutes of meeting, new added features to the HIS, training manuals and briefing notes. This is to ensure that all levels of HIS users are fully informed and aware on HIS adoption activities and plans.

5.9 HIS Assimilation Barriers at the Routinization Stage

Barriers to the routinization stage involve elements that the Alpha Hospital should overcome in sustaining the use of HIS. The identified barriers at this stage should be handled properly, efficiently and responsibly by the hospitals top management. Table 21 lists all the identified routinization barriers and the relationship of these barriers with the healthcare IS/IT literature.

Table 21 Routinization Barriers

<table>
<thead>
<tr>
<th>Assimilation Stage</th>
<th>Barriers</th>
<th>Consistency with theory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Routinization</td>
<td>Clinical &amp; IT Governance</td>
<td>A strong clinical and IT governance systems to account for the organisation’s IS/IT application in Cooper &amp; Zmud (1990)</td>
</tr>
<tr>
<td></td>
<td>Proactive communication</td>
<td>Effective communication is a key to successful implementation of healthcare technology especially in providing ongoing proactive communication about consequences of changes in processes (Damberg et al. 2009)</td>
</tr>
<tr>
<td></td>
<td>24X7 technical support</td>
<td>Technical support is critical for the sustained use of healthcare applications (Castillo, Martinez-Garcia &amp; Pulido 2010)</td>
</tr>
</tbody>
</table>

Generally informants from the Alpha Hospital responded that they are currently at the routinization stage of their HIS assimilation, despite the existence of people, process, technology and environment issues. Their perspective on being at the routinization stage is perceived as having a system that is considerably matured and being used by everyone despite the fact that they have no other options to carrying out their duties other than to use the system. It was clearly stated by two of the management team, that even though everyone had no other option but to use the system, somehow that “force” has brought about good in terms of HIS utilization:
“we gave them no choice in the sense that it's a big bang, first day you open this hospital we start using IT. So, there was no choice of paper. In that sense, somehow we overcome that obstacle.”

[MD1, Management]

This was also endorsed by the IT department representative stating that:

“If there was no directive from the higher management it would be a bit difficult. But when the Medical Director says you have to do it in such and such way, the success would be greater.”

[IT5, IT Department]

Some clinicians do point out concerns over the way the HIS was being introduced. The clinicians’ concerns do imply that there should have been other options or stages involved in introducing the HIS to medical areas that are critically in need of the HIS technology. Studies should have been done to further improve future deployment to other medical departments in order to obtain greater success. This is stated in the clinician’s response as follows:

“we can initiate something, and see how it goes but try to look at these tedious problems and try to rectify it first. Maybe when we implement it we should have implemented it in a small scale, start with a place that requires the system a lot then from there identify if there are problems, rectify it then only introduce to other departments. Start small then move it bigger....”

[SD1, Clinical]

All staff members are doing their best in performing their respective roles and duties whilst dealing with the HIS inadequacies, especially in handling medical data. This study’s findings also indicate that the greatest facilitator of the routinization stage is to have strong clinical and IT governance in order to achieve understanding and support from higher management. This is especially relevant in terms of the financial ability to keep abreast with the vast technological changes occurring in the medical industry.
The HIS requires constant updates, and, based on the feedback from the hospital management and IT department staff, it is not practical to maintain a legacy system for longer than 3 to 5 years if it is not upgraded to newer versions. The staff comments were in response to the infrastructure and hardware issues that were still apparent after a decade of the HIS being in service. Staff of the Alpha Hospital were still using decade old machines and servers as a result of numerous unsuccessful requests of change in hardware for the entire hospital throughout the last 5 years. The necessity for hardware change was again as a result of ineffective planning during the initiation stage, where the team involved could not anticipate the high maintenance costs that would occur over a long time period. The enthusiasm of the Malaysian government and key players during the initiation phase was solely focused on launching an ambitious and powerful system in a public hospital to meet their ultimate goal of being the first in the world to have an end-to-end IS/IT of a healthcare service.

However, they were oblivious to the needs of maintaining the system once it had been deployed. This fact is in support of the theory suggested by Fichman & Kemerer (1999), that new technology may be introduced with great enthusiasm and the widespread anticipation of the initial acquisition is enjoyed, but the technology still fails to be thoroughly deployed in the acquiring organisation. This leads to the assimilation gap in which the use of cumulative acquisition as a basis for diffusion modelling may lead to potentially erroneous judgements on the robustness of the observed diffusion process and future prospects of the technology (Fichman & Kemerer 1999). Therefore, it can be argued that the success of the routinization stage heavily relies on solid clinical and IT governance. Further, a strong planning team to foresee maintenance plans and identify resources needed to adequately maintain and provide efficient support for the system in terms of technical, human and financial resources is also essential at the routinization stage.

Another barrier to the routinization stage was the lack of proactive communication with regard to the HIS improvements. The clinicians would like to be aware of the current status and development of the HIS through an efficient form of communication, such as
an electronic means. An online discussion platform or regular HIS email updates on the changes or upgrades that are to take place or have already taken place is necessary. This ongoing means of communication would enlighten the users as to how these changes will affect their use of the HIS in performing their duties. This was highlighted by one of the active clinical user of the HIS at the Alpha Hospital when he suggested that:

“If you have a monthly update on the ITD (IT Department) especially on the systems capabilities and changes, firstly it would help on what can be done, and what can’t be done, a simple one or two page PDF file, not too long, something concise.”

[SD1, Clinical]

There is a constant hope by the staff for improvement knowing that the current HIS version does not meet their expectations especially with the recent technological advancement and needs of the medical industry (Andersson, Vimarlund & Timpka 2002; Barnes 2001; Bramble et al. 2010; Hsiao et al. 2009; Jao, Helgason & Zych 2007; Lucas 2008; Paré, Jaana & Sicotte 2009; Radhakrishnan, David & Zaveri 2008; Reichertz 2006; Spil & Stegwee 2001; Wickramasinghe & Goldberg 2008).

Problems arise when there is a loss of support from application IT vendors, a lack of funding available for upgrades and the constant change of local IT vendors assigned for managing technical support and maintenance. This study’s findings also revealed that the hospital management overlooked the fact that they are not only to obtain committed support from the clinicians, but also from the government at Ministry level especially in creating awareness of the importance of system maintenance and support for the HIS once it has been deployed.

“The management support is very important, and the management must also understand the need to spend money, because maintaining a hospital that is using IT is very costly. Furthermore, if it was not done in a correct manner.”

[IT5, IT Department]

“The Ministry Of Health are not even sure what is it that we want out of this IT, even though I've been telling them about this ..the hard work is here.”

[Mr. C, Clinical & IT]

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This is in support of the findings by Wager, Lee & Glaser (2005), that too often the organisation feels that the work is completed once the system has gone live and the organisation has eliminated the importance of system maintenance, support resources and evaluation of the system to observe if it has achieved its targeted goals. It is crucial to note that in the routinization stage, adequate resources to provide technical and maintenance support to the HIS in a 24 hours, 7 days a week and 365 days a year scenario, have to be accessible to the clinicians at all times. The technical support team has to also meet their key performance indicators in resolving issues being escalated and ensure that problems are immediately attended to and that solutions are being provided promptly in order not to jeopardize any work requirements of the clinicians involving life and death situation.

5.9.1 Implications and Recommendations for Practice at the Routinization Stage

It is important that the clinical and IT governance structure produces policies and procedures in governing the operations of the HIS. In overcoming this barrier a structured approach involving the development of a proper management and operations plan of each medical department with a comprehensive description on the use of the HIS, the department’s work procedure manuals, work instructions and reference documents would be useful to be used as guides in performing operations and maintenance service activities.

The daily operations of the Alpha Hospital require a 24 hour per day, 7 days a week, 365 days per year technical support to the users of the HIS. It is the responsibility of the Head of IT department to identify and roster technical support staff according to problem types. There has to be a proper system to accommodate technical support processes involving users submitting requests and complaints, prioritisation of problems, mechanism to escalate these problems to suitable sections and relevant staff of the IT department or if necessary to log a second level support call to the original suppliers in providing a solution.

The technical support process can be structured in such a way that it involves three main levels of support. The first level of support involves the first point of contact between the
user and IT department. The first level support receives complaints or requests and logs the call. Assessment and evaluation is made by the first level support to decide if the problems can be rectified immediately or escalated to the second level support. When support calls involve problems with rectifying database, transaction overload or minor changes to codes in the application, these issues can be solved by the clinical IT experts or application specialists. However, should problems persist; the call is then escalated to the third level support, which involves the HIS application developers.

There must also be a means of communication to update issues and notify the status of the logged problem to the users. The technical support team is also responsible in technical surveillance of the HIS through system monitoring of the system memory utilization, storage capacity and network traffic. System monitoring may be performed using a third party network and system monitoring tools, server monitoring tools, database monitoring tools and user usage audit.

### 5.10 The HIS Assimilation Framework

The focus on HIS assimilation in the Alpha Hospital supports the theory of diffusion modelling that, from a practical perspective affects the larger portion of the hospital’s population. Further, from a technical perspective, appears to be successful based solely on the idea of having new innovation acquired in the organisation but nevertheless failed to be deployed (Fichman & Kemerer 1999). As highlighted in the previous chapters, this research focuses on the HIS, a technology that was implemented in a public hospital with an end to end computerization.

Analysis of this study identified gaps between the assimilation stages, revealing global and local barriers that should be addressed in all and specific assimilation stages in order to provide successful HIS assimilation. Despite the elucidation of the global and local barriers, to obtain a more descriptive and consistent picture pertaining to successfully assimilation of the HIS, the people, process, technology and environment components were identified to provide key facilitators for success. Based on the barriers and facilitators identified above, the initial conceptual model was altered to portray a better descriptive version of HIS assimilation for hospitals. This is illustrated in Figure 18.
5.11 Case Study Reflection

The findings of this study highlight the fact that successful assimilation of the HIS in a public hospital is highly complex. The adoption and use of the HIS is relatively slow and requires continuous improvement in sustaining its use. This view is supported in the literature by various scholars who support the contention that there are still issues with the healthcare sector that is slow in adopting HIS and sustaining the use of these systems (LeRouge, Mantzana & Wilson 2007; Spil & Stegwee 2001; Suomi 2001).

5.11.1 Lessons Learnt from the Alpha Hospital

Having had no professional involvement with the Alpha Hospital prior to the research, the staff of the Alpha Hospital should be commended on their initial effort of trying to produce an end-to-end integration of clinical applications across all departments in the hospital. This plan was drafted at a time when IT vendors were still concentrating on providing different applications to different departments and no other countries were attempting this initiative. The medical staff, especially the pioneering team consisting of senior surgeons and clinicians, should also be applauded for having provided tireless efforts involving brainstorming the healthcare IS/IT structure of the Alpha Hospital, even
though they possessed very limited IS/IT knowledge at the time. Although there was a strong team at the Alpha Hospital who were all very enthusiastic in realizing the end-to-end IS/IT for the hospital, the assimilation was compromised due to circumstances beyond their control, and included issues such as budget constraints, political intervention and changes in government policies.

The existence of IT nurses and the IT clinical coordinator of the Alpha Hospital held by clinical personnel in high regard as a great influence in the success of assimilating the HIS. Having people with the knowledge of both IS/IT and medical provides a link in obtaining a better understanding of the clinician’s needs and requirements. The requirements of clinicians usually involve their daily tasks, procedures and events that are commonly coded using the standard medical nomenclature, which is sometimes difficult for IS/IT personnel with very limited medical knowledge to understand. In view of this, the IT nurses and clinical coordinators are able to describe and explain the requirements of clinicians more clearly to the IT department since they are able to translate better from one field to another. This will potentially decrease the issue of having clinicians not being understood by their IS/IT team and having applications developed which do not meet their needs and work processes (Anderson & Aydin 2005).

5.11.2 Lessons Learnt from HIS Assimilation

It is clear from the findings of this study that successful assimilation of an HIS involves more than proper planning and implementation at the initial stage. Successful assimilation also requires clinical governance in understanding the needs of healthcare IS/IT, maintenance of the systems throughout adoption and the input of clinical IS/IT experts. Clinical management support in terms of technical knowledge and financial resources must be accompanied by strong leadership and critical understanding of the demands of a computerized medical facility in order to promote the extensive use of HIS through to its routinization stage. However, with the absence of good leadership and knowledge of the HIS demands, the system remains part of the organisation’s value chain activities, but has failed to meet its intended benefits. The absence of sufficient knowledge after a new IS/IT has been adopted in a healthcare facility is also supported by the findings of Fichman & Kemerer (1999) and further supported by Zhu, Kraemer & Xu
(2006), who add that the organisation and its members usually lack sufficient knowledge to gain control and manage the system after new IS/IT was adopted. This then causes an issue with the fit between the technology acquired and the end user’s work context. As a result, systems may be abandoned or utilized less due to being irrelevant to the work environment.

5.11.3 Lessons Learnt from this Study

This case study dealt with people at many levels across various departments and the data obtained was examined using a qualitative approach with thematic coding. The use of thematic coding in this study served as an excellent tool in categorizing, describing and organizing raw data into meaningful themes, which provided rich and detailed data for the study. Various levels of analysis were done on the themes, which also led to the discovery of emerging themes and significant findings. In understanding the concept of conducting analysis using the thematic approach, categorization and theme identification may begin as early as during data collection. Listening to informants respond to interview questions may trigger categorization through the mind and initiate the beginning the data familiarization. The next step is to produce interview transcripts – a process that can be very complicated and exhausting. Nevertheless, it is an excellent way to start familiarising oneself with the data. Familiarization of data is crucial especially in ensuring that the depth and breadth of data is captured in order to derive meaningful concepts and patterns.

Findings from the analysis of each theme identified elements that could influence successful assimilation of HIS within a particular hospital. Through analysis of data, barriers were also identified and categorized as either global or local for each assimilation stages. Since this was an embedded single case study, examining the opinions and experiences of the individuals has led to an in depth understanding of a specific case and situations studied at a specific site. The data has provided rich information and insights pertaining to the case study, however this reduces generalisability (Bostrom & Heinen 1977). Therefore, it must be clearly understood that the findings of this research are unique to the Alpha Hospital alone and at best can be used only as a guide to compare or make judgements about other hospitals assimilating HIS.
5.12 Summary and Next Steps for the Alpha Hospital

The Alpha Hospital recognises the importance of the HIS as a strategic part of the clinical operations and healthcare delivery of the hospital. The importance of an IT governance structure for the Alpha Hospital is critical as a way to move forward. The Alpha Hospital has reached the final stage of assimilation and the way forward is to plan for further improvisation, continuous effort on checking milestones that need to be reached and to keep the momentum going in sustaining the use of the HIS.

Currently the process of maintaining the HIS is the hardest experience for the Alpha Hospital. This becomes harder considering the fact that the use of IS/IT in healthcare is significantly dynamic and a rapidly evolving discipline. To keep the momentum going, the clinical governance must be sensitive and adaptive to change. There must be a mechanism for improvising the clinical governance structure to institutionalise change, perform ongoing audits, monitoring and process review, reinforce business and IS/IT realignment continuously, with outsourcing IT vendors and encourage knowledge management amongst staff.

An important practice that should be utilised to ensure the HIS is always performing at its best is to conduct reporting and statistical analysis. In the near future, it is recommended that assessment be carried out to solicit understanding of the Alpha Hospital’s medical staff in the context of understanding the hospital’s strategy, direction, issues and how these elements impact the assimilation of the HIS. Staff should also understand the Alpha Hospital’s technology development and how these technologies may best be assimilated to support the overall objective of providing excellent patient care and medical treatment. It is also imperative that the senior management and the Malaysian Ministry of Health have a shared view of the current role of the HIS and its impact on hospital operations, and the consequences to overall healthcare delivery if the barriers and issues were resolved.

Therefore, it is recommended that the Malaysian Ministry of Health and the Alpha Hospital address the barriers and facilitators according to the HIS assimilation
framework, which covers all the HIS assimilation stages. It is also recommended that in order to enhance the functionalities within the IT department, especially in formalizing the role of clinical IT experts and application specialists, the hospital senior management and health ministry need to review the existing policies and regulations pertaining to resource allocation in accordance with the fact that these resources provide substantial benefits to both the clinical and IT departments.

In successfully assimilating HIS, accountabilities and responsibilities must be fully understood and enforced. Contracts, guidelines, regulations and policies must be transparent and strictly followed. As a referral and tertiary hospital, it is proper for the Alpha Hospital to set up an electronic knowledge repository and communication on the clinical workflow, process manuals, training, and training material pertaining to the HIS. This knowledge repository may be separated into a clinical knowledge repository and a technical knowledge repository. The clinical knowledge repository will be used by clinical staff as a means of proactive communication with regards to the use of the HIS especially in finding out about the latest updates to the HIS applications. The technical repository will be used by the IT department and maintenance IT vendor in sharing technical knowledge and solutions especially in resolving technical support calls. It is also recommended for the Alpha Hospital to appoint a Chief Information Officer (CIO) to be responsible for the overall maintenance of the HIS applications, IS/IT infrastructure, patient data and medical records.

The ongoing issue with the use of the HIS at the Alpha Hospital is that the system constantly hangs and delivers poor quality of service due to a multitude of factors as described earlier in the previous sections. The newly formed CIO position and the IT team must establish a plan to ensure that the hospital is able to continue its functions despite faults and hitches with the HIS through a business continuity plan. The business continuity plan involves proactive and preventive precautions and measures to minimize downtime, mechanisms to ensure that various functions of the hospital dependent on the HIS are able to continue working during any complete or partial system downtime, and methods for restoring the HIS to its original state on recovery from serious incidents. A
careful planning preparation has to take place in scheduling for system downtime. Users must be informed well in advance of the proposed downtime and activities carried out on the HIS during downtime. The outsourced IT vendor and IT department will be working together in ensuring that the business continuity plan is in place and regularly reviewed with the approval of senior management and the ministry. Actions must also be taken to impose penalty charges to the outsourced IT vendor if the maintenance activity or issues failed to be resolved within a specified number of hours. This is to ensure that critical departments such as emergency and critical wards do not suffer from data lost and work redundancy due to delays in restarting the system. It is also the vendor’s responsibility in ensuring that all backup has been done and mechanisms for restoration and recovery are in place for the purpose of post-disaster.
CHAPTER 6

6 Conclusion

This research set out to develop a healthcare information systems (HIS) assimilation model for a Malaysian public hospital to successfully assimilate and sustain the use of its HIS. Specifically, this research aimed to answer the research question:

“How can a systematic focus on assimilation facilitate sustained use of healthcare information systems (HIS)?”

Followed by two research sub-questions:

“Why is assimilation of HIS important?” and

“Why are healthcare information systems generally poor with regard to sustained use?”

In understanding the HIS and issues pertaining to the HIS assimilation, the Malaysian public hospital, identified as the Alpha Hospital in this research, was critically examined on its dynamics and experience with HIS assimilation. This exemplar case study indicates significant findings and important recommendations for the Alpha Hospital, as well as other hospitals in a similar context.

One of the major findings of this research in terms of the people component, is the existence of champions or clinicians with IS/IT, clinical and core business process understanding is crucial in bridging communication gaps in relation to HIS assimilation technical and business requirements. As for the process component, financial issues are seen as the major barrier and facilitator in which funding for HIS assimilation should come from the government's dedicated budget and should not be considered as a per project basis. With regard to the technology and environment, the constant reminder of having ongoing technical support for maintenance by competent IT vendors and promoting a more balance approach towards providing better transparency in the selection of these competent IT vendors is critical.

The next section will begin with section 6.1 providing answers to the main research question, and sections 6.2 and 6.3 addressing the sub-questions. In concluding the study,
this chapter will also highlight the changes in the research framework in section 6.4, the contribution of this research to assimilation theory in section 6.5 and the contribution to of this research to practice in section 6.6. Finally, the chapter will address the way forward, through sections 6.7 and 6.8 addressing the limitations and future study of this research.

6.1 How can a Systematic Focus on Assimilation Facilitate Sustained Use of Healthcare Information Systems (HIS)?

In answering the research question, a structured approach through the investigation and consideration of all major components facilitating the success of HIS is necessary to address requirements of each of the assimilation stages from initiation to adoption and finally to routinization. Facilitating components, consisting of people, process, technology and environment elements, highlight the importance of developing knowledgeable people in both medical and IS/IT fields, of having a structured IT governance, and the presence of sophistication in healthcare IS/IT infrastructure, work culture and balance in organisational politics, good system design and the need for standards in healthcare technology implementation.

The existence of people with both medical and IS/IT knowledge is critical especially in bridging communication gaps between both fields in fulfilling user needs and system requirements. A specific healthcare IT governance structure is also essential in ensuring goal alignment between the IT department and organisational goals, and externally between the healthcare organisation and outsourced IT vendor companies. The IT governance structure simultaneously addresses issues relating to IS/IT adoption and implementation, which include financial, human IS/IT resources and procurement issues. The assimilation of HIS will inevitably incur expensive investment; nevertheless, with a proper IT governance structure and effective financial planning, assimilation will result in better management of investment and maintenance costs leading to substantial savings for new innovation and further system optimization projects. A structured and effective procurement system should also be in place, allowing for transparency in the selection of IT vendors, regardless of the IT vendors being local or international companies. IT vendors should be selected on the basis of healthcare IS/IT knowledge and capability in
delivering high quality medical systems with excellent customer service and technical support services.

Formalizing standards of technology implementation is necessary to coordinate implementation and development activities among healthcare technology IT vendors. With proper standards of healthcare IS/IT application development and implementation, data and system synchronization could be achieved thus providing a more consistent platform for future HIS integration.

6.2 Why is Assimilation of HIS Important?

HIS assimilation is important as healthcare organisations are facing crisis due to the global exponentially increasing healthcare costs and government in most countries around the world believed that IS/IT is central in resolving this situation. Thus, it is apparent that a myriad of e-health and/or IS/IT innovation projects in healthcare are currently initiated and implemented in various countries. However, many of these initiatives and innovations are unsuccessful. Therefore, HIS assimilation offers a possible solution to ensure the likely success of HIS within the e-health projects.

Despite the numerous issues encountered by the medical staff of Alpha Hospital, the HIS undeniably provided valuable assistance to the clinical work practices, especially in storing and retrieving information on patient’s medical histories. The use of the HIS also promotes familiarization of clinical computation among medical professionals. Efficient services providing almost immediate clinical test results have subsequently lead to easier and faster decision making on the patient’s medical treatment. The HIS has also been acknowledged as a medium of communication amongst medical staff in providing a diagnosis for cross department cases.

6.3 Why are HIS Generally Poor with Regards to Sustained Use?

The HIS was initially found by this research to be poor in relation to sustained use. Through the findings of the research analysis, this was found to be the case for the Alpha Hospital and is attributed to barriers that occur globally throughout all the assimilation stages of the HIS, and locally at specific stages of HIS assimilation. Global barriers involve all levels of assimilation and include overcoming financial difficulties,
overcoming political influences and a lack of up-to-date knowledge on healthcare technology and systems. The local barriers, such as lack of leadership, lack of efficiency of IT vendor support and proactive communications, must be addressed in each assimilation stage to ensure that preventive measures have been taken to avoid abandonment of the HIS.

Overcoming financial difficulties is crucial because the assimilation of healthcare IS/IT requires a prolonged state of monetary investment from the Malaysian government, especially during system maintenance. Efficient planning and allocation of the healthcare IS/IT budget from the government is crucial in supporting the entire assimilation process which will result in sustaining the use of the HIS. The political barriers in many of the government organisations cause complications in many parts of the organisation, particularly the work processes. Overcoming political barriers requires a change in work culture, good governance and a high degree of political and administrative commitment by the top government authorities. It is imperative to adopt a more transparent way of managing the current business practices relating to IT vendor selection and procurement processes. A strong senior management team that promotes accountability, transparency and upholds strong ethical values in realizing organisational objectives in providing better health and quality of service to the people is essential.

An appointed champion amongst senior clinicians with strong healthcare IS/IT knowledge is mandatory to promote sustained use of the HIS, and a change in work culture is required to improve communication gaps between the medical and IS/IT field. It is crucial for both areas to understand the latest advancement in medical technology and to possess an understanding of clinical procedures in order to achieve the aims of having successful use of an end-to-end hospital IS/IT facility. Better communication amongst staff may also lead to an improved work culture and a more flexible and collaborative work environment.
6.4 The Research Framework

The initial conceptual model, consisting of technology-organisation-environment components, was altered to provide a better descriptive version of HIS assimilation for hospitals. The new framework incorporates people, process, technology and environment components as facilitators to the HIS assimilation success. Based on the analysis of findings of this research, the framework also incorporates global and local barriers that healthcare organisations must address to ensure better progression of the HIS at every assimilation stage.

6.5 Contribution to Theory

In ensuring that the HIS is assimilated successfully in a healthcare facility, elements in the technology-organisation-environment framework (Tornatzky & Fleischer 1990) require further enhancement in tailoring the framework to the needs of a healthcare organisation. Hence, specifically for the healthcare context, the components of people, process, technology and environment can be postulated as being facilitators for technology innovation. As facilitators, they influence the way that the healthcare organisation realizes the needs and searches for ways to adopt new technology. However, these facilitators are not without barriers that the organisation has to overcome, both globally and locally, in each stage of the innovation assimilation.

It is also due to these barriers that the gaps identified by Fichman & Kemerer (1999) and Zhu et al. (2006), pertaining to the level of enthusiasm amongst HIS users is generally higher during initial stage of assimilation, and lower during the later stages of assimilation, exists. In the context of a healthcare environment, being oblivious to these barriers during the initial stages causes the information systems deployment and adoption to result in disappointment or failure. Members of the healthcare organisation, not realizing that other barriers exist in later stages of assimilation, are often deprived of, or possess very limited skills and knowledge to use and maintain the HIS. Ultimately, this causes major misalignment between the new HIS being implemented and the medical professionals’ work environment.

It should be noted that many of the findings, while they haven’t been explicitly discovered in the context of healthcare, have been discussed to a greater or lesser extend
in other industries, example banking and finance; and thus noting this occurrence in healthcare context shows that in many ways healthcare is not so dissimilar to other industries and this therefore is also a contribution.

6.6 Contribution to Practice

The Alpha Hospital’s business operation runs under a very dynamic environment where referral cases and unexpected situations are addressed by staff daily. The most challenging goal for the Alpha Hospital is to provide excellent service in patient care and medical treatment whilst eliminating medical errors. The use of the HIS was aimed at providing assistance to clinicians and the allied health services staff. The assimilation of this technology has been introduced on a large scale without consideration of the impact on the maintenance and use of the HIS.

In view of the Malaysian context, this research supports the contention of Kumar, Krupinski & Abdullah (2008) that the implementation of the Malaysian IS/IT in healthcare requires a realistic assessment, especially in producing very clear policy, a committed leadership, and an efficient assimilation program. Furthermore, a suitable IT governance structure is required in public healthcare facilities to better manage IS/IT acquisition, deployment and services. The government, senior hospital management and staff should also recognize that the HIS is an enabler to assist work practices of the clinical and non-clinical staff, and that it is not the ultimate solution in solving all issues pertaining to healthcare in Malaysian public hospitals. The HIS cannot be taken as a solution to solve equity issues when the financial obligations have to be fulfilled by the Malaysian government. As revenues from general taxation have been used to subsidize health services, it is imperative that the Malaysian government works to provide essential services and to achieve the equity objective of providing better healthcare services with the assistance of technology innovation.

This research supports Kumar, Krupinski & Abdullah’s (2008) view that even though technology is available and it may be possible to solve many potential healthcare issues in Malaysia with its use, the selected technology is not without its people, process, technology and environmental issues.
This research suggests that, to overcome these issues, the following implications and recommendations should be considered by hospitals assimilating technology in a similar context:

1. The formulation of a knowledgeable group of project committee members comprising of active technology users from every department in the hospital.

2. The reorganisation of the IT team to have a strong senior management team consisting of a Chief Information Officer (CIO), chief technology officer (CTO), chief security officer (CSO) and chief medical informatics officer (CMIO) - with the appropriate experience in both IS/IT and medical field.

3. The alignment of the selected IT vendor organisation goals to the hospital’s IS/IT strategic goals to ensure high quality delivery and support.

4. The need to conduct frequent assessment of the selected IT vendor company on the efficiency and effectiveness of their IS/IT services.

5. The need to adopt a customized IT governance structure specific for the healthcare organisation.

6. The need to have strong clinical governance in place as this is especially crucial in promoting and sustaining the use of the HIS across all levels of healthcare staff.

7. The need for transparency that will help to promote positive values of integrity and honesty in procurement and IT vendor selection process.

8. The need for education, training and awareness in IS/IT, medical advancement and work culture.

9. The need for strong leadership by the organisation’s senior management team.

10. The need to have a systematic and structured 24 hour, 7 day per week, 365 days per year technical support process.

11. The need for effective communication mechanism with all staff of the healthcare organisation.
12. The need to maintain positions of IS/IT Application Specialists and Clinical IT coordinators/experts with clinical background and strong IS/IT knowledge in the IT department.

13. Given that this study has shown that many of the issues with IS/IT in healthcare contexts are similar to those in other contexts, it would be useful for the implementation team in hospitals to also look at lessons learnt from other contexts when engaging in projects focusing on HIS assimilation.

It is interesting to note that some of these recommendations are consistent with IS/IT implementation best practices (Channin, Bowers & Nagy 2009; Clacy & Jennings 2007; Johnson et al. 2007; Kapron 2009; Rinderle-Ma et al. 2010; Wagner 2006). This also strongly suggests that there is a correlation between the IS/IT implementation best practices in healthcare context and successful HIS assimilation. Moreover, given the current and continued importance of IS/IT for healthcare, this would appear to be an important relationship to examine in detail in future research.

6.7 Limitations

This research has three limitations pertaining to the units of analysis, use of Malay language in some of the interviews and the difficulty of being consistent with interview protocols. In relation to the units of analysis, it is noted that the study might have provided the Ministry’s decision makers perspective if it was possible to interview more senior management such as the State Health Director, Director General for Medicine and senior representatives from the Malaysian Ministry of Health. Specifically, this could have enabled a higher level view on the initial and future plans for the HIS assimilation. However, given the healthcare context is made up of a web of players, therefore it was impossible to interview representatives from all groups and capture all perspectives. Further, the goal of this research was to obtain rich responses from participants on the experience of using the HIS; hence the responses provided by the clinical and non-clinical staff of the Alpha Hospital were considered to be most informative.

In considering the comfort of the participants during the interview, all participants were asked if they would like the interview to be conducted in English, Malay or both.
Although, most clinicians responded fully in English, nevertheless there were some who were more comfortable in expressing their views in Malay especially when describing certain cultural scenarios that did not have a direct English translation. The use of English and Malay language adds complexity to the analysis as some points could have been lost during translation. This is one of the dilemmas of doing a qualitative research where the researcher has to accommodate both the comfort of the participant and the accuracy of data.

As the enthusiasm of the participants increases during the discussion of the HIS assimilation issues, which causes the interview to divert to other related matters, it was difficult to ask the participants to stick to the interview protocols. This is a challenge for most exploratory research as it requires skills for the researcher to keep participant’s enthusiasm in responding to the questions and not be distracted with other non-related issues. Nevertheless, all the information provided was useful for data analysis.

6.8 Future Study

To date, the area of HIS assimilation remains poorly understood. However, given the growing focus globally for an increasing need of IS/IT as a means to effecting and enabling superior HIS delivery, it becomes of paramount importance to further investigate the components of HIS assimilation. This is critical, and in order to understand this key process more fully, it is essential that future studies build on the important findings of this research. The next step for assimilation research is to carry out more investigation to examine in greater detail the specific barriers and facilitators identified in this study in other healthcare contexts to provide more insights into HIS assimilation. Multiple case studies carried out in various hospitals achieving similar levels of HIS assimilation will be conducted to further improve the generalizability of the findings. Given the growing significance that IS/IT will play in enabling superior healthcare delivery, the vital role for successful assimilation of HIS needs to be further addressed by calling for more research in this important area.
Appendix 1 – Alpha Hospital’s Organisation Chart
Appendix 2 – Organisation Chart for Malaysia Ministry of Health
Appendix 3 – Interview Questions and Plain Language Statement
Interview questions

1.1 Profile of interviewee
   a) What is your position in the hospital?
   b) How long have you been in the current position?
   c) What are your job tasks?

2.1 Short answer questions - HIS
   a. What is the objective of the HIS?
   b. Who are the main users?
   c. For what purposes do you make use of HIS?

This research involves classifying the assimilation stages of the HIS into Acquisition, Adoption and Routinization. (Each of the assimilation stages will be explained to the interviewees).

Assimilation: A series of stages beginning from the organization’s initial evaluation of the potential system to be used to its formal adoption and finally to a well accepted deployment of the system to a point where it becomes an important part of the value chain activities.

Acquisition: The first stage of assimilation where preliminary technology adoption activities are carried out such as evaluating the potential benefits of the system, vendor evaluation, proposal evaluation, etc...

Adoption: The next stage of assimilation where decision is made to introduce, implement and use the system for hospital activities.

Routinization: The third stage of assimilation where the system is widely used as an integral part of the hospital’s value chain activities.

d. In your opinion at which stage is would you define HIS currently?

   e. Were you excited when you were first introduced to the HIS?
   f. How do you feel about it now?
3.1 Questions that require elaboration:

a. What is your opinion on the current performance of the HIS? Good in terms of what? Problematic or not so bad – what is lacking?

b. Does the HIS work fully according to its objective(s)? Yes, how? No, Why?

c. Could you please explain some of the problems encountered during the system acquisition stage?

d. How do you ensure success during the initiation stage?

e. In your opinion, what are some of the main things that influences the success of the HIS initiation?

f. Could you please explain some of the problems encountered during the system adoption stage?

g. How do you ensure success during the adoption stage?

h. In your opinion, what are some of the main things that influences the success of the HIS adoption?

i. Could you please explain some of the problems encountered during the system routinization stage?

j. How do you ensure success during the routinization stage?

k. In your opinion, what are some of the main things that influences the success of the HIS being a routine?

Do you have any questions or concerns about this interview?

Thank you for your time
INVITATION TO PARTICIPATE IN A RESEARCH PROJECT

PROJECT INFORMATION STATEMENT

Project Title:
Healthcare Information System Assimilation: Malaysian hospital context

Investigators:
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Dear Participant

You are invited to participate in a research project being conducted by RMIT University. This information sheet describes the project in straightforward language, or ‘plain English’. Please read this sheet carefully and be confident that you understand its contents before deciding whether to participate. If you have any questions about the project, please ask one of the investigators.

This research is being conducted by Hidayah Sulaiman, a Business Information Systems PhD student enrolled in the School of Business Information Technology. The research is supervised by Prof Nilmini Wickramasinghe of the School of Business Information Technology & Logistics, RMIT University. The main aim of this study is to develop a healthcare information system assimilation model for hospitals to successfully implement healthcare information systems. This research shall explore the adoption and implementation processes involving the hospital information system. Therefore, the research question would be ‘How can a systematic focus on assimilation facilitate sustained use of healthcare information systems (HIS)? Why is assimilation of HIS important? Why are HIS generally poor with regard to sustained use?

The research will be conducted through a series of interviews with key people in your department. A total of twenty (30) participants of different departments in the hospital are expected to participate in individual interviews. You are being invited to participate because you are directly involved in the support and implementation of HIS in the hospital.

Your responses to the interview questions will be kept strictly confidential and available only to the researcher and her supervisors. If you agree to participate, you will sign a consent form prior to the interview. The interview will take about one hour. With your permission, the interview will be tape-recorded to ensure the accuracy of the data collected. You reserve the right to stop this
recording anytime during the execution of the interview. Your response (both in the form of short notes and tape recorded) will be transcribed with very high care and accuracy and then kept securely in electronic form. The access to the data is limited only to the researcher and her supervisors. You will also be asked for approval of the transcribed version before it is being used for analysis. Your details will not be disclosed in any research report or publication. The data collected will be analysed and results may be published in academic journals and conferences without any information that can potentially identify either you or your hospital, unless you give us written permission to do otherwise. In accordance with Human Research Ethics Committee guidelines, research data will be securely retained for a minimum of five years after publication, and then securely destroyed.

There are no foreseen risks associated with your participation in this research project. The benefits of participating in this research may be the opportunity for you to reflect back on your IT/IS adoption and implementation with your current medical and administrative processes while sharing your insight about any problem you might have encountered using the hospital information system. In addition, your participation in the research might yield some suggestion in better managing HIS implementation issues. Any information that you provide can be disclosed only if (1) it is to protect you or others from harm, (2) a court order is produced, or (3) you provide the researchers with written permission.

Your participation in this research is voluntary. As a participant, you have the right to withdraw your participation at any time; have any unprocessed data withdrawn and destroyed, provided it can be reliably identified, and provided that so doing does not increase your risk; and have any questions answered at any time.

If you have any questions regarding this research, please contact either the researcher or her supervisor at the address above.

If you agree to participate, please complete the enclosed informed consent form and return it to the investigator below.

Yours Sincerely,

Hidayah Sulaiman
(PhD research candidate)
RMIT University

Prof Nilmini Wickramasinghe
(Research supervisor/ Senior lecturer)
RMIT University
Prescribed Consent Form for Persons Participating In Research Projects Involving Interviews, Questionnaires, Focus Groups or Disclosure of Personal Information

Name of Participant:

Project Title:
Healthcare Information System Assimilation: Malaysian hospital context

Name(s) of Investigators:
(1) Hidayah Sulaiman
Phone: +61 3 9925 1509

(2) Prof Nilmini Wickramasinghe
Phone: +61 3 9925 5969

1. I have received a statement explaining the interview/questionnaire involved in this project.
2. I consent to participate in the above project, the particulars of which - including details of the interviews or questionnaires - have been explained to me.
3. I authorise the investigator or his or her assistant to interview me or administer a questionnaire.
4. I give my permission to be audio taped: [ ] Yes  [ ] No
5. I give my permission for my name or identity to be used: [ ] Yes  [ ] No
6. I acknowledge that:
   (a) Having read the Plain Language Statement, I agree to the general purpose, methods and demands of the study.
   (b) I have been informed that I am free to withdraw from the project at any time and to withdraw any unprocessed data previously supplied.
   (c) The project is for the purpose of research and/or teaching. It may not be of direct benefit to me.
   (d) The privacy of the information I provide will be safeguarded. However should information of a private nature need to be disclosed for moral, clinical or legal reasons, I will be given an opportunity to negotiate the terms of this disclosure. If I participate in a focus group I understand that whilst all participants will be asked to keep the conversation confidential, the researcher cannot guarantee that other participants will do this.
   (e) The security of the research data is assured during and after completion of the study. The data collected during the study may be published, and a report of the project outcomes will be provided to (researcher to specify). Any information which may be used to identify me will not be used unless I have given my permission (see point 5).

Participant's Consent

Name:  Date:  
(Participant)

Name:  Date:  
(Witness to signature)

Where participant is under 18 years of age:

I consent to the participation of _________________________ in the above project.

Signature:  (1)  (2)  Date:  
(Signatures of parents or guardians)

Name:  Date:  

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