SUCCESS FACTORS FOR HOSPITAL INFORMATION SYSTEM IMPLEMENTATION IN PUBLIC UNIVERSITY HOSPITALS

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DEDICATION

To my loving Parents

Dr Shohreh Beheshti & Dr Gholam Reza Rezaian

And

My Darling Sisters

Dr Shema, Dr Shahed & Dr Sheeda

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ABSTRACT

Hospital Information System (HIS) could help the delivery of high quality health services and improve patient care and patient safety. The development and the adoption of the system need to commence if high quality patient care is to be provided. However, successful HIS implementation is not an easy task and it depends on multiple factors such as adequate computer skills, lack of training and education. Despite the presence of a literature on nurse's satisfaction on HIS, there is still a controversy over the success of HIS implementation. The input from the Information and Organisation culture, Trust and the nurses themselves, have not been considered. The aim of this study therefore, is to identify the success factors that influence a successful HIS implementation and to propose a research model which could fulfil the objective. Based on DeLone and Mc Lean′s information, a success model system with an addition of four additional factors namely the Information culture, Organisational cultures, Trust and User quality was developed in this study. Employing a quantitative research methodology, this study began by conducting a pilot study involving 160 nurses from a university hospital to validate the reliability of the questionnaire to be used. Then, 1200 questionnaires were distributed to seven public university hospitals in Iran and 1028 (86%) usable responses were used for analysis. The covariance-based on structural equation modelling using STATA was employed to evaluate the model. Findings revealed that fourteen out of sixteen proposed hypotheses are significant on successful HIS implementation. The Information quality, Service quality, Organisation culture and the Information culture were among the most influential constructs in the final model. As the study was empirically tested in the Iranian setting, it contributes to theoretical and practical aspect of research especially in the Iranian public university hospital context.

ABSTRAK

Sistem Maklumat Hospital (HIS) boleh membantu penyampaian perkhidmatan kesihatan yang berkualiti tinggi dan meningkatkan penjagaan pesakit dan keselamatan pesakit. Pembangunan dan penggunaan HIS perlu dibangunkan jika penjagaan pesakit yang berkualiti tinggi perlu disediakan. Walaubagaimanapun pelaksanaan HIS yang berjaya bukanlah tugas yang mudah dan bergantung kepada beberapa faktor seperti kemahiran komputer mencukupi, latihan yang banyak dan pendidikan. Walaupun terdapat kesusasteraan mengenai kepuasan penggunaan sistem oleh jururawat, terdapat banyak kontroversi mengenai kejayaan pelaksanaan HIS. Dapatan dari maklumat dan budaya organisasi, kepercayaan dan jururawat-jururawat sendiri, juga tidak diambil kira. Tujuan kajian ini adalah untuk mengenal pasti faktor- faktor kejayaan yang mempengaruhi pelaksanaan HIS yang berjaya dan mencadangkan model penyelidikan yang dapat memenuhi objektif. Berdasarkan model DeLone dan Mc Lean, sebuah model kejayaan dengan empat faktor tambahan iaitu budaya maklumat, budaya organisasi, kepercayaan dan kualiti pengguna telah dibangunkan dalam kajian ini. Dengan menggunakan metodologi penyelidikan kuantitatif, kajian perintis melibatkan 160 jururawat telah dilakukan untuk mengesahkan kebolehpercayaan instrumen soal selidik yang bakal digunakan. Model pemodelan persamaan struktur kovarians menggunakan STATA telah digunakan untuk menilai model tersebut. Penemuan menunjukkan empat belas daripada enam belas hipotesis yang dicadangkan adalah penting untuk pelaksanaan HIS yang berjaya. Kualiti maklumat, kualiti perkhidmatan, budaya organisasi dan budaya maklumat adalah antara konstruk yang paling berpengaruh dalam model akhir. Disebabkan kajian ini telah diuji secara empirical dalam persekitaran Iran, ia menyumbang secara signifikan kepada aspek teori dan praktikal untuk penyelidikan terutamanya dalam konteks hospital awam di Iran.

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LIST OF ABBREVIATIONS

CFA	-	Confirmatory Factor Analysis
SFs	-	Success Factors
D&M	-	DeLone and McLean
EFA	-	Exploratory Factor Analysis EHR
EHR	-	Electronic Health Record
EMR	-	Electronic Medical Record
HIS	-	Hospital Information Systems
HIT	-	Health Information Technology
ICT	-	Information and Communication Technology
IQ	-	Information Quality
IS	-	Information Systems
ISQ	-	System Quality
IT	-	Information Technology
LR	-	Literature Review
MOH	-	Ministry of Health
PLS	-	Partial Least Squares
SEM	-	Structured Equational Modelling
SQ	-	Service Quality
UTTU	-	Use/Intention to Use
US	-	User Satisfaction

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CHAPTER 1

INTRODUCTION

1.1 Overview

Healthcare is the maintenance or improvement of health via the prevention, diagnosis, and treatment of disease, illness, injury, and other physical and mental impairments in human beings (Taib *et al.*, 2011). Healthcare is delivered by health professionals. Healthcare information systems refers to such systems that are used to process data, information and knowledge in healthcare environments (Ahmadi *et al.*, 2015; Dünnebeil *et al.*, 2012). The information system for hospitals is generally termed as Hospital Information System (HIS). It helps to manage the information which is required for health professionals in order to perform their jobs effectively and efficiently (Shortliffe and Cimino, 2013).The main advantages of an HIS include improvements at management, clinical, and production levels in an organization. At the management level, the HIS assists managers in conducting strategic planning, and technology assessment. At the production level, the HIS can lead to better utilization of resources through computerization. Furthermore, the HIS can contribute better communication, thereby reducing the waiting time for orders, information, and results, and eliminating unnecessary services.

In general, HIS has introduced several important changes in the health care system some of which include; 1) speeding up communications, 2) eliminating or reducing redundant data or procedures, 3) minimizing error rates, 4) organizing data to aid decision making for diagnosis and therapy and 5) playing a role in auditing clinical activity (Kruse *et al.*, 2016).

There exists a potential for HIS to significantly change and increase the overall quality of health (Blumenthal and Tavenner, 2010). This is evidenced by the investments that are currently being pumped into the HIT development and adoption

(Blumenthal and Tavenner, 2010; Kramer *et al.*, 2010; Wang and Biedermann, 2012). HIS is expected to increase legibility, reduce medical errors, shrink costs and boost the quality of healthcare (Blumenthal and Tavenner, 2010; Jha, 2010).

One of the primary motivators for adopting health IT applications is the belief that they improve the quality of patient care and patient satisfaction. Quality health care relies on physicians, nurses, patients and their families, and others having the right information at the right time and using it to make the right decisions. Recent studies have shown that adoption of HIS in hospitals can improve communication and coordination among physicians (Roham *et al.*, 2012; Tabibi *et al.*, 2011), increase service productivity and patient satisfaction (Jarvis *et al.*, 2013).

The implementation of HIS into a clinical environment will inevitably affect both nursing practice and the related processes of patient care (Gephart *et al.*, 2015; Huston, 2013). There is scanty nursing specific research literature exploring the impacts of HIS and its implementation within the nursing context (Gephart *et al.*, 2015; Oroviogoicoechea *et al.*, 2008; Pringle and Nagle, 2009). Nurses represent the largest cohort of healthcare providers in the hospital (Canadian Institute for Health Information, 2013). Due to nurses' central role in coordinating patient care, they are considered "key collectors, generators, and users of patient information" (Urquhart *et al.*, 2009). As such, implementing HIS into environments where nurses' work has the potential to alter nursing practice, through changes to work processes and flow; interdisciplinary communications; and the redefinition of various point-of-care activities. Since hospitals are a primary area of employment for many nurses, understanding the role of nurses and their interaction with health technology (including HIS) can have significant impacts on the role of the nurse and patient care (Remus and Kennedy, 2012).

1.2 Background Problems

A large number of hospitals, all over the world, including those in Asia have implemented or are in the process of implementing HIS to be competitive with other

healthcare centers and maximize hospitals efficiency (Escobar-Rodríguez and Bartual-Sopena, 2015).

Since the process of IS acceptance and adoption is a complex one and depends on multiple factors such as inadequate computer skills, lack of training and education, these studies have been conducted to explore the factors that control the process of accepting and adopting the technology among individuals or groups (Ismail *et al.*, 2015; Khalifa, 2014; Özogul *et al.*, 2009). However, these studies are often incomplete in their description or characterization of the problems, as well as in proposing a methodology to follow in order to achieve a successful implementation. Such studies are incomplete as there are multiple contributing factors that determine the success or failure of IS implementation especially in the developing countries (Travis *et al.*, 2004; Zhang *et al.*, 2005).

Therefore, the success factors and dimensions for IS implementation vary from one institution to another, country to country, and it is difficult to formulate a unified implementation plan for all organizations. Some of the most important healthcare information technology and HIS issues especially relating to Iranian nurses include User, Human, the organization and technology (Ajami and Bagheri-Tadi, 2013).

The need for user involvement and the allied need for user education and training are, if anything, more acute. User involvement should be much more extensive and literal (Monem *et al.*, 2013; Zakaria and Yusof, 2016).The project group needs to make sure that users get familiar with system specifications, discuss implementation plans, and fit them into meetings once every so often. Over all when nurses feel that the hospital managers expect them to use computer systems they will be encouraged to use HIS much more and better (Sharifian *et al.*, 2014). Human issues is represented by resistance to change (Ayatollahi *et al.*, 2014; Jung *et al.*, 2013). Lack of incentive to use HIS and lack of HIS experience and skill are also among such issues especially in developing countries like Iran (Ahmadian *et al.*, 2017). The main problem related to the organization resources is the lack of appropriate facilitating equipment, such as well-functioning computers which can delay data entry.(Garcia-Smith and Effken, 2013). Lack of in-service training is also a common issue in Iranian hospitals

(Ahmadian *et al.*, 2017). Technological issues, hardware and software complexity and display of unnecessary information in the system. The challenges involved in building information infrastructures are accompanied by issues of privacy, security, and confidentiality (Ahmadi *et al.*, 2014; Ismail *et al.*, 2010; Masrom and Rahimly, 2015).

A great deal of studies have been based on the interaction between User, Human, the organizational and technological. Information Systems implementation by itself does not improve the institutional efficiency and depends on other influential factors such as people who will use it, the organizational tasks and structure.

The literature includes IS implementation case studies (Lu *et al.*, 2012), as well as discussions of problems, or success and failure factor. (Lorenzi *et al.*, 2009). The process of implementing IT is complex and consumes a substantial amount of time, effort, and money. Moreover, IS project failures are very common; only 29% of projects fully succeed, about 52% partially fail and 19% of projects have total failures and are abandoned (Hastie and Wojewoda, 2015). As stated by (Krigsman, 2011) "*Common knowledge and experience tell that huge, open-ended enterprise software implementations are expensive and risky. Packaged solutions are a direct response to customers demanding faster, lower cost, and higher value software implementations*".

HIS are currently considered a major part of the healthcare system, on which the processes of care delivery depend (Ismail *et al.*, 2010). The importance of these systems emerges from the importance of their role in managing all data and information including key personal data about the patient and other comprehensive medical data; documenting all medical services that have been provided to the patient (Shortliffe and Cimino, 2013).

Despite all the advantages and potential benefits, the implementation of HIS in most of developing countries is still facing many challenges and barriers that are completely different than challenges faced in developed countries. Some of these challenges may include inadequate budget, education, trained personnel, appropriate software, hardware or other equipment necessary to maintain the system. In addition, insufficient computer skills of the physicians, nurses, technicians and the

administrative personnel are other important barriers for HIS implementation in the developing countries (Ajami and Mohammadi-Bertiani, 2012; Altuwaijri, 2012; Khalifa, 2013).

Lack of stable electricity, internet access and other basic infrastructures are still additional contributing barriers for HIS implementation in some of these countries (Benson and Dha, 2011). Although that HIS can improve quality, safety and reduce costs; implementation of HIS in developing countries is still not as successful as planned (Khalifa, 2014). The level and extent of usage of HIS in developing countries is still poor and far less than expected (Altuwaijri, 2012). Problems with HIS usability – especially when users have inadequate computer skills– caused users to spend extra work time to learn effective ways to use the (Asangansi *et al.*, 2008; Khalifa, 2013). These substantial problems decrease their use of HIS and increase their resistance, which lowers the potential for achieving quality improvement. The great resistance of physicians and other healthcare professionals to accept and use health information systems and electronic medical records is probably one of the major barriers that delayed the adoption and successful implementation of HIS. This is why the process of HIS and EMRs implementation should be treated as a change project, and led by change managers, in medical practices.

The analysis of the human barriers of adopting and successfully implementing HIS and electronic medical records could reveal a lot of factors related directly to the beliefs, attitudes and behaviours of healthcare professionals and believing in HIS and EMR systems, motivation and personal initiative to explore and use the systems and user-developed strategies and workarounds to solve minor difficulties (Holden, 2011; Hoover, 2016).

Nurses, as the largest group of HIS users and providers, are invariably affected by the introduction of such technologies (Mahalli, 2015; Waneka and Spetz, 2010). As HIS, understanding the role of nurses and their interaction with these technologies can have an impact on nursing processes and overall quality of care (Dünnebeil *et al.*, 2012). Although nurses are the most numerous of healthcare providers (Canadian Institute for Health Information, 2013) and often the largest group of HIS users

(Waneka and Spetz, 2010), nurses are often underrepresented in the implementation process. For example, decisions regarding system selection, design modifications, and strategies to integrate a new HIS are commonly made by hospital management. Thus, any exploration of HIS used by nurses is highly informed by the decisions and actions conveyed by the organization's leadership team (Remus and Kennedy, 2012). Nurses' attitudes have been defined as a key factor for HIS acceptance and use (Kimiafar *et al.*, 2014; Nagle *et al.*, 2014). Several studies also suggested that nurses' attitudes regarding HIS use are favourable, as nurses believe HIS benefit patients (Ahmadi *et al.*, 2015; Kimiafar *et al.*, 2014), enhance patient care and satisfy nursing information needs (Hyun *et al.*, 2009).

There are several important facts which justify HIS implementation in any health care institution. Quality data are considered to be a key component in decision making at all levels of health care. Adopting systems to provide the data and information that are necessary to the decision making process is becoming essential in today's competitive health care environment (Hoover, 2016; Lorenzi *et al.*, 2009).

IT may provide a tool to store, integrate, and update this information base. However, the high costs associated with such advanced information systems, lack of technical and computer skills of the physicians, nursing staff and technicians are only a few main barriers to be addressed (Borycki *et al.*, 2011; Haughom *et al.*, 2011).

Despite all these benefits, health care delivery system is facing different obstacles during HIS implementation. The success of such systems is dependent upon many factors. Such factors must be identified and considered to ensure successful system implementation.

There is still inadequate acceptance and usage of HIS in the nursing process especially in the developing countries including Iran. In other words, there is a gap in the implementation of HIS especially the willingness among nurses to use it in practice. In addition, the information culture (Choo, 2013; Heath and Appan, 2014; Mukred *et al.*, 2013, 2017), the organization culture (Abubakre *et al.*, 2014; Chipunza and Malo, 2017; Xie *et al.*, 2013; Yan, 2018), trust (Costa *et al.*, 2018; Dissanayake,

2013; Legido-Quigley *et al.*, 2014; Platt and Kardia, 2015), User quality (Aggelidis and Chatzoglou, 2012; Ahlan and Ahmad, 2014; Dastgir and Mortezaie, 2012; Monem *et al.*, 2013).

1.3 Problem Statement

Despite the rapid growth of technology, successful implementation of HIS is still low. This explains why HIS has become "one of the brightest, most challenging and most promising fields of research, education and practice for medical informatics. The substantial disappointment following unsuccessful implementation is partly due to the complexity of the Health Information System itself. Moreover, a majority of implementation projects take a long time to complete; thereby straining implementation budgets. In Iranian hospitals, the level of integration of IT into the healthcare delivery system has been unsatisfactory. In particular, the acceptance and tendency for HIS implementation are low. In the field of nursing, as the amount and nature of the necessary information has become more complex, HISs have been introduced to support nurses' daily activities. The effect has been to improve clinical documentation and to reduce the duplication of care services, thereby improving the quality of patient care and enhancing decision making. In addition, the use of HIS enables nurses to record data quickly, and to represent nursing interventions with little effort and high quality. This, of course, requires the encouragement of nurses to develop their documentation and informatics skills. Therefore, understanding the factors that promote effective utilization of the HIS by healthcare providers, especially nurses, is a vital issue for healthcare industry of Iran and other developing countries. In addition, nurses' satisfaction of HIS will help achieving a desirable system implementation. Assessment of nurses' satisfaction as one of the main HIS users, therefore, should be included in this group.

In addition, despite the presence of an extensive literature on HIS user satisfaction, there exists much controversy over the adequacy of user satisfaction measures to ensure the success in HIS implementation. However, the nurse's role in HIS implementation has been constantly neglected. Furthermore, the information

culture, organizational culture, trust and facilitating conditions have been insufficiently dealt with, too. Therefore, this study intends to identify success factors for HIS implementation in Iranian public university hospitals based on the perspectives of nurses, which can help the hospital management to align the success factors with the implementation of HIS. It has to be mentioned that the aforementioned hospitals include public university teaching hospitals which use HIS actively by the staff nurses and physicians. Other public hospitals on the other hand, are covered by non-university physicians and nurses.

1.4 Research Questions

Based on the aims of our investigation and the need to understand the success factors that could influence successful HIS implementation in Iranian public university hospitals, the major research questions in the study are formulated as follows:

1- What are success factors for HIS implementation in Iranian public university hospitals?
2- How to ensure the success of the implementation of success model in Iranian public university hospitals?
3- How to evaluate the proposed model for HIS implementation in Iranian public university hospitals?

1.5 Research Objectives

Objective 1: To examine and identify the success factors needed for HIS implementation.

Objective 2: To propose a success model for HIS implementation in Iranian public university hospitals.

Objective 3: To evaluate the proposed success model in Iranian public university hospitals.

1.6 Scope of the Research

This study focuses on the viewpoints of Iranian public university hospital nurses in regards to the factors which positively or negatively affect the HIS implementation in their hospitals. The hospitals were selected among different public university hospitals of two major cities (Tehran and Shiraz) in Iran. Tehran University is the oldest one and is considered to be the most high-ranking educational organization in Iran. Shiraz University has the same reputation and position in the southern part of the Iran. Therefore, this study intends to identify success factors for HIS implementation in Iranian public university hospitals based on the perspectives of nurses, which can help the hospital management to align the success factors with the implementation of HIS.

1.7 Significance of the research

There are some significant contributions which this research will be able to address. This research is intended to not only evaluate a theoretically-based model of HIS implementation success, but also to contribute to our understanding the factors such as organization culture, information culture, trust and user quality that can affect the successful outcome of HIS implementation. It will also provide information that identifies areas that need improvement. In addition, this research may help to build a better health care system that is safe, effective and efficient and give hospital managers a blue print to supervise the HIS and utilize it through the mission and goals of the organization. It is undeniable that nurses are the largest group of healthcare providers in any hospital and are amongst the principal users of HIS. This work, therefore, could have crucial implications for nursing staff and help them to better understand and identify the factors that can facilitate HIS usage.

1.8 Definitions

The following technologies and terms are often included in discussions of information technology in health care:

Electronic health record (EHR): EHRs were originally envisioned as an electronic file cabinet for patient data. Now, they are generally viewed as part of an automated order-entry and patient-tracking system providing real-time access to patient data, as well as a continuous longitudinal record of their care.

Hospital Information System (HIS): A HIS is a comprehensive, integrated information system designed to manage all the aspects of a hospital's operation, such as medical, administrative, financial, and legal issues and the corresponding processing of services.

Electronic Medical Record (EMR): EMR is the systematized collection of patient and population electronically-stored heath information in a digital format.

1.9 Organization of the Thesis

This thesis comprises six chapters. Chapter 1 provides an overview and background of the research. It also designates the significant issues motivating this research including the problem statement, research questions, research objectives, research scope, and significant contributions of the research.

Chapter 2 presents a comprehensive review of the relevant literatures. The chapter begins with the definition of HIS and subsequently the components of HIS and its implementation are defined. The gaps in the literature, the antecedents influencing the successful implementation of HIS as well as its use and outcomes are reviewed.

Chapter 3 represents the model formulation of this research. The chapter begins with the justification of models selected for this research. The discussion on the selected model, namely DeLone and Mclean (2002) IS success model is described. Moreover, it also discusses the need for addition of other constructs to the D&M success model to develop the research model. In addition, the research variables, and hypotheses formulation are described.

Chapter 4 illustrates the research methodology used in this research. The description of research methods in the field of information system are defined. It is followed by the rationale of selecting the quantitative research approach. Next, the explanation of each phase in the research process consists of the investigation, data collection and data analysis, and report writing are described.

Chapter 5 presents the qualitative analysis, the quantitative analysis and findings. It starts with the respondent's profile for preliminary investigation, and then followed by its findings. Data collection and data examination comprises the response rates, non-response bias, common method bias, missing value, and normality assessment are presented. Then, the descriptive statistics for demographic are described. Next section explains the exploratory factor analysis followed by the confirmatory factor analysis. Additionally, the structure equation modelling which includes the evaluation of the measurement model and structural model, hypotheses testing, and analysis of mediation effects are described. The final research model is presented at the end of this chapter.

Chapter 6 concludes the research with the research objective achievements and discussion on the research findings. The research contributions from theoretically, methodologically, and practically aspects are described. It also discusses the limitations of this research and recommendations for future research. It ends with the concluding remarks. Figure 1.1 Show Summarizes the chapters involved in this thesis.

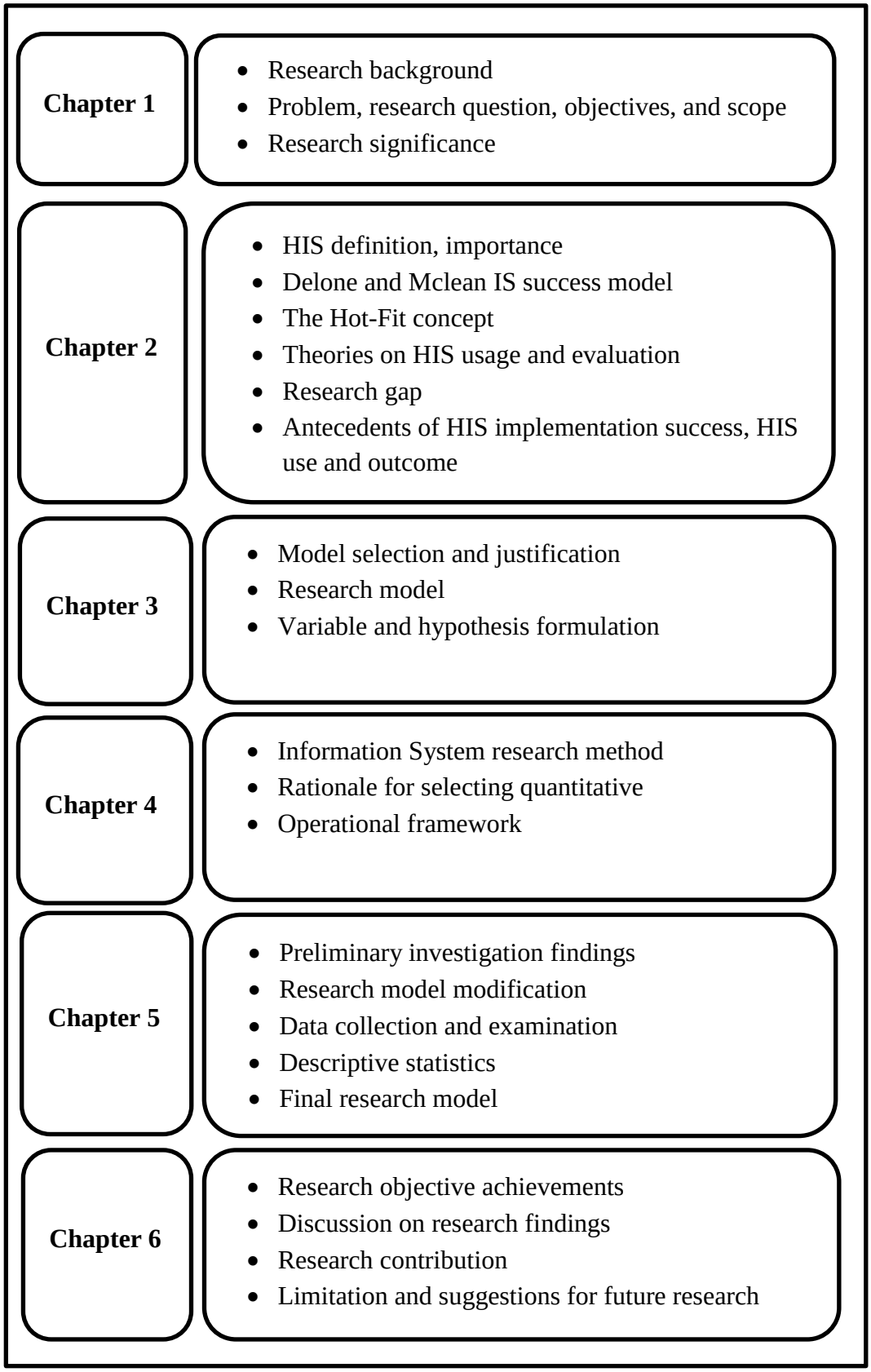

Figure 1.1 Thesis organization

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