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A FUNCTIONAL AFFORDANCE AND BOUNDARY SPANNING BASED EXPLORATION OF A SUCCESSFULLY ADOPTED HEALTHACARE IS

by
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APPROVAL PAGE

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DISSERTATION APPROVAL PAGE

This is to certify that the thesis prepared by Deema Al-Sekait entitled "A Functional Affordance and Boundary Spanning Based exploration of successfully Adopted Healthcare IS" has been approved by this committee as satisfactory completion of the requirement for the degree of Doctor of Science in Information Technology.

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DEDICATION

This dissertation is dedicated to my loving parents, who have instilled in me wonderful values about the importance of obtaining knowledge. My adoring mother, my role model, my inspiration and cheerleader, Dr. Awatif Alkeneibet, who always believed in me, constantly encouraged me to aim high and pushed me to improve for my best efforts in the quest of learning. My caring father, Dr. Mohammed AlSekait, my constant source of support, who has been putting his own priorities on hold to stand by me. I realize the sacrifices I made were not alone; family time was reduced, important engagements were missed, and countless frustrations were shared. I will always appreciate the love and faith exhibited by my family, who walked by my side and dragged me towards this rewarding goal. I thank you for making this possible, for your positive expectations, for your patience, and love.

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ABSTRACT

Information Systems (IS) have become critical for healthcare organizations. However, implementation and adoption of integrated healthcare IS continues to be a non-trivial task. The use and implementation of healthcare IS has increased considerably in the past decade, particularly because of their perceived criticality to quality patient care. However, healthcare IS development projects have been marred with reports of failures, leading to a lesser percentage of successful adoption. This research argues that such failures emerge from inadequate development of linkages between the behavioral context of the organization and specification models developed for a typical healthcare IS. Consequently, this dissertation suggests the use of affordances as a theoretical lens that could potentially mitigate such issue. In addition, this study argues that a successful use of IS within a healthcare organization also requires the organization's IT-group to act as the boundary-spanning agent that translates the meaningful use of the IS. This premise is examined through an empirical investigation of a successfully adopted healthcare IS developed in Saudi Arabia. Preliminary exploration identifies an initial set of affordances that could be used to develop design prescriptions for a more robust IS. The theoretical narratives further elaborate on the boundary spanning role played by the IT group of the organization in developing a meaningful healthcare IS.

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1. INTRODUCTION

Medical errors, which refer to the mistakes committed while treating patients, are ranked among the leading causes of deaths across globe. In the United States, medical errors are reported to be claiming lives of more than 400,000 people each year (James, 2013), a figure that makes this preventable cause of death the third leading cause of mortality, closely following heart disease and cancer (Zineldin, Zineldin, & Vasicheva, 2014).

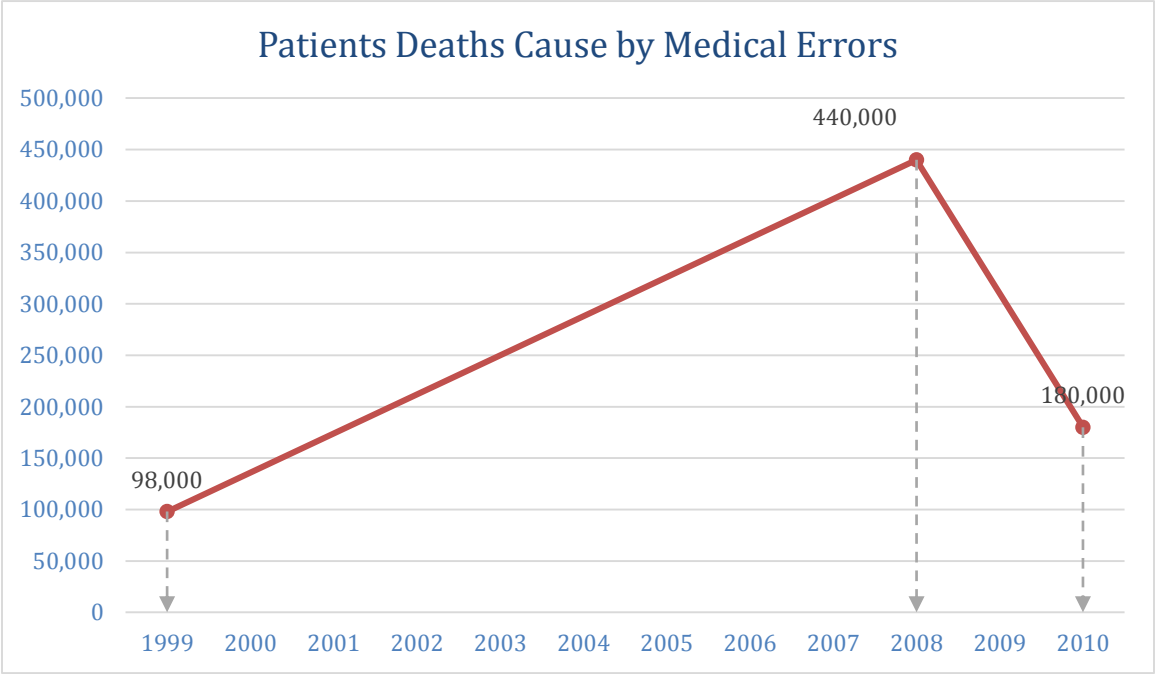

Figure 1.1 Patients Deaths Chart Caused by Preventable Medical Error

The chart above illustrates the drastic increase in number of deaths caused by preventable medical errors in the US in the past decade, including the first record established in 1999 (Kohn, Corrigan, & Donaldson, 2000) of a total of 98,000 patients deaths (See

Figure 1.1). The last number was established later in 2010 by the Department of Health and Human Services. The report indicates a decreased number record of 180,000 Medicare patients' annual deaths caused by the same preventable reasons (James, 2013).

Consequentially, there has been a recent increase in healthcare information system (IS) implementation and use in the healthcare sector (Blaya, Fraser, & Holt, 2010). These systems (e.g. electronic health record systems) are those that singly or in co-operation with other systems facilitate and enable treatment of patients, and are distinct from other enterprise levels systems used by healthcare organizations. A significant benefit of such systems is the reduction of medical errors - mistakes committed while treating patients, and ranked among the leading causes of deaths across globe. In the United States, medical errors are reported to be claiming lives of more than 400,000 people each year (James, 2013), a figure that makes this the third leading cause of mortality, closely following heart disease and cancer (Zineldin (Zineldin et al., 2014). In addition, research also suggests that such IS is critical to a healthcare organization for reasons of efficiency, safety of its patients, better treatment, and also for legal compliance (Chaudhry et al., 2006; Haux, 2006; Meystre, Friedlin, South, Shen, & Samore, 2010).

Nevertheless, despite the rising popularity of IS implementation in the healthcare sector and availability of data showing successful IS development projects, a significant number of projects fail (Cortex, 2010). Another similar pervasive theme is that of challenges to the implementation and adoption of a healthcare IS (Berner & Moss, 2005; Sood et al., 2008). Several authors highlight the low adoption rate to the healthcare system of twenty percent or less. Moreover, poor integration of the system results in inducing new errors and yielding frustration with user interfaces and recurring tasks (Aarts & Koppel, 2009). Given

the repeated nature of such findings, it makes sense to understand how organizations can overcome these obstacles. This dissertation attempts to do so by carrying out an empirical investigation of a successful IS adoption and use in a healthcare setting.

Existing research has suggested that flaws in requirements specifications or design specifications, often result from a disjoint between the sociotechnical context of an IS, and the requirements and design models developed during and Information System Development (ISD) (e.g. (Chakraborty, Rosenkranz, & Dehlinger, 2015; E. J. Davidson, 2002; Marakas & Elam, 1998; Mathiassen, Saarinen, Tuunanen, & Rossi, 2007). Given this, it is perhaps not a stretch to assume a potential for such disjoint in a significant number healthcare related ISD projects. In addition, it may also be useful to explore the reasons for such a disjoint as means to mitigate failures of healthcare IS.

This research argues that a possible reason for such disjoint could be the somewhat distinctive context that healthcare organization represents. In particular, key members of such organization who would typically be heavily involved in using the IS, are members of healthcare professions (e.g. doctors, nurses, and pharmacists), which typically are bound to regulations and norms that extends beyond the organizations (Charette, 2006). In addition, there are also certain accepted hierarchical relationships between such professions, and each has a pre-ordained role within a healthcare organization.

Therefore, if one considers a typical healthcare organization such as a hospital, key operational processes such as workflows related to patient processing would require extensive collaboration. Further, such collaborative process would need to maintain the integrity of the norms of the extended professional groups from each of these professions (Currie & Suhomlinova, 2006).Consequently, work processes within healthcare

organizations require collaborations amongst these different professions. Such collaboration need to necessarily comprise of significant boundary-spanning activities (i.e. communication across boundaries of the distinct groups of users) (Currie & Suhomlinova, 2006). Existing research suggests that in such a collaborative context, boundary-spanning is facilitated by boundary objects that inscribe such interaction (Barki & Pinsonneault, 2005; U Schultze & Boland Jr, 2000; Swaminathan, 2001).

Correspondingly, boundary-spanning related studies confirm how technology facilitates this collaboration by developing technological artifacts (boundary objects) that allow translation of information among the different medical professions. Such development is maintained through continuous evolution of these boundary objects (Bechky, 2003; Carlile, 2004; Orlikowski, 2000). Yet, designing, developing, and evolving boundary objects is not a trivial task. It requires boundary spanning agents that can translate the norms for agents collaboration into explicit, functional boundary objects in use, and maintain them (Friedman & Podolny, 1992).

Healthcare related studies investigated this phenomenon and argued how a healthcare IS represents such a boundary object by facilitating collaboration among the distinct medical groups within and across an organizational boundaries (U Schultze & Boland Jr, 2000). Therefore, it may be argued that a healthcare IS (a boundary object) that would typically be central to such collaboration, would need to explicitly inscribe within it the norms for these collaborative interactions, for any expectations of its successful development.

If one accepts such a premise, a useful direction of investigation into successful healthcare IS could be the examination of how IS design could be more strongly linked to the socio-technical context of a healthcare organization. In other words, explore which work

practices within a healthcare organization can be more closely linked to the physical design of an IS, in terms of the system and interface capabilities and features.

This research argues, that affordances (Gibson, 1977; Leonardi, 2011, 2013; Markus & Silver, 2008; D. A. Norman, 1999) represent a conceptual perspective that would facilitate such an investigation. An affordance can be understood as "what the [IT] artifact allows humans to do" (Yoo, 2010, p. 222), representing "the possibilities for goal-oriented action afforded to specified user groups by technical objects" (Markus & Silver, 2008, p. 622). Conceptually, an affordance is tied to the user's task related objectives. Therefore, it represents more than capabilities or features of a system, which allows for a more explicit and simultaneous exploration of designed capabilities of a healthcare IS and the collaborative interaction it needs to facilitate.

Consequently, this dissertation represents two major key aspects to reach the research objective. The first aspect argues that such identification of affordances represents a novel perspective that could provide important implication to the design of a healthcare IS (boundary object). In other words, an exploration of the IS affordances within a healthcare context would facilitate an understanding of the linkages between the collaborative interactions needed by healthcare professions, and the attributes expected from a healthcare IS. The second key aspect of this dissertation suggests that a successful introduction and use of a an IS within a healthcare organization, requires its IT professional group or IT department to act as a boundary spanning agent between the diverse medical professions (Levina & Vaast, 2013). Consequently, this research is guided by the following questions:

1. What is the influence of the functional affordances of a healthcare information system in developing a collaborative space within a healthcare organization?

2. What is the nature of the boundary-spanning role played by the IT team in implementing and maintaining an integrated IS in a healthcare organization?

This dissertation reports the exploration into the nature of a successful use of a healthcare IS. The study adopts an interpretive case research approach to examine how affordances could be represented in a healthcare IS, and the role of the IT department in developing and designing a well developed IS in a healthcare organization. Specifically, this research analyses the case of a successful implementation and use of a healthcare IS, based on an interpretive analysis of empirical data collected from healthcare professionals affiliated to a large hospital in Saudi Arabia.

This dissertation is structured in the following way: the next chapter elaborates on the existing literature on Healthcare IS and IS design relating to technology. Chapter Three describes the methodological approach used to contribute this study. Chapter Four provides the theoretical narrative that emerged from the empirical investigation. The last chapter concludes with a discussion of the contributions and implications of this research.

2. LITERATURE REVIEW

2.1. Introduction

The key to efficient provision of healthcare is the design and implementation of healthcare Information Systems (IS) to improve patient's healthcare quality and increase treatment productivity. Although published studies have shown countless benefits to using healthcare IS, numerous challenges hinder the process of developing an integrated system such as political, strategic and structural barriers (Barki & Pinsonneault, 2005; Ettlie, 1988; Hitt, Hoskisson, & Nixon, 1993). Consequently issues related to digitization practices are a primary concern for the healthcare sector, and the IS discipline (Chaudhry et al., 2006; Sood et al., 2008).

The purpose of this chapter is to present an overview of the currently available literature relevant to healthcare information system (IS). It provides a fresh perspective on the question of how healthcare IS is implemented and used efficiently. This literature review contributes to the IS research by providing a synthesis of key research findings, while identifying gaps in research.

This chapter comprises of five sections where each section provides a literature analysis of a single theme. The review starts with an overviews of the available literature on the use of IS in healthcare organizations, including the factors that influence success of failure of a healthcare IS. Then, the review focuses on the collaborative nature of the medical professionals and the significant boundary spanning activities found in healthcare organizations. This chapter also reviewed a brief background of the different types of affordances related to the IS use, and their implications for IS design. The chapter ends by

providing a summary and reviewing the identified research gap that the present study seeks to meet. The following section elaborates on the different databases and search strategies used to conduct this review.

2.2. Literature Search Strategy

The literature review began with the identification of suitable journals and publication databases. Given the IS premise of this research, the researcher focused on Top IS journals proposed by the Association for Information Systems (AIS) (Schryen, 2014). As for the databases, the researcher used EBSCO Information Services, which provided accessibility numerous databases. For example, the study benefited from the services provided by AIS Electronic Library (AISeL), ScienceDirect, Google Scholar, and Microsoft Academic Search.

As for the healthcare ground of this research, the researcher used different services from the National Library of Medicine (NLM), The National Center for Biotechnology Information (NCBI), the Medical Subject Heading (MeSH) browser, Pubmed and different Dissertation Abstracts. The first step of the search process started with searching of terms related to the general topic, using these combined terms: (a) healthcare, (b) Information Systems, and (c) Hospital Systems.

The terms were also used independently and in various combinations for additional results. Then, the researcher narrowed down the search with related keywords, which were found useful for identifying related topics. For example, some of the additional keywords were: (a) *Hospital Information Systems* (HIS), (b) *Electronic Health Record* (EHR), (c) *Healthcare Systems*, (d) *Interface Design and healthcare*, (e) *Healthcare success factors*, (f) *Affordances*, (g) *Functional Affordances*, (h) *Healthcare Boundaries*, and (i) *Boundary Spanning*.

The last step of the literature review process involved a backward search, as in reviewing the citations for the articles identified in the first step (Webster & Watson, 2002). Adapting this search strategy was very helpful towards the literature examination process for reviewing the different published literature related to this study (Schryen, 2014; Tate, Furtmueller, Evermann, & Bandara, 2015).

The following section further presents the reviewed literature relevant to healthcare information system (IS), starting with an overview of the use of Information Systems in a healthcare setting.

2.3. Use of Information Systems (IS) in Healthcare

A recent trend in the research of healthcare information technology has been towards a closer integration of the different organizational players within the healthcare sector (Blaya et al., 2010; Charette, 2006). The International Organization for Standardization (ISO) has defined Healthcare IS as "a means to the repository of patient data in digital form, stored and exchanged securely, and accessible by multiple authorized users. It contains retrospective, concurrent, and prospective information and its primary purpose is to support continuing, efficient and quality integrated healthcare" (K. Häyrinen, K. Saranto, & P. Nykänen, 2008, p. 294; ISO, 2011).

Healthcare information systems (IS) unite the areas of information technology and health, to build up the systems necessary to manage the growth of information, high-level clinical workflow, and develop the security of the healthcare system. Additionally, healthcare IS engages the incorporation of computer technology, information science and medicine to gather, systematize, and protect information and health related data (Zineldin et al., 2014). The explosion of medical data and information, technologies, and ground-breaking drugs can

very much enhance healthcare deliverance to customers (Chaudhry et al., 2006; K. Häyrinen et al., 2008; ISO, 2011; Zineldin et al., 2014).

Previously carried out studies have established three different categories of healthcare IS: Time-oriented, Problem-oriented and Source-oriented systems (Kristiina Häyrinen, Kaija Saranto, & Pirkko Nykänen, 2008). According to the authors, time-oriented healthcare IS presents data in the time in which it was received. Problem-oriented IS focuses on the fact that information related to the patient and problems are described in detail. Finally, the source-oriented record offers "notes of visits, X-ray reports and blood tests" (Kristiina Häyrinen et al., 2008, p. 294).

Numerous studies have also examined the usage of Information Systems (IS) in healthcare industries. For example, published studies have discussed the significance of using modern information technology (IT) to create a healthcare IS in a hospital setting (Haux, 2006). Healthcare related literature has noted numerous benefits that emerged from the usage of such healthcare IS (Chaudhry et al., 2006; Khoury, 1998; Tierney, Miller, Overhage, & McDonald, 1993). The subsequent section elaborates on these benefits that emerged from reviewing related published studies.

2.3.1. Benefits

There has been an extensive research about Information Systems (IS) implementation and use in the healthcare sector (Blaya et al., 2010). A theme that emerged from this research is how an organizational IS is critical to a healthcare organization for reasons of efficiency, safety of its patients, better treatment, and also for legal compliance (Berner & Moss, 2005; Braa, Monteiro, & Sahay, 2004; Chaudhry et al., 2006; Meystre et al., 2010; Vest & Gamm, 2010). Numerous studies also examined Information System (IS) implementation and use in

the healthcare sector, in an effort to increase healthcare efficiency, and improve patient care quality (Blaya et al., 2010; Haux, 2006)

A similar theme that emerged from the literature review highlighted the countless benefits that emerge from adopting a healthcare IS (Berner & Moss, 2005; Braa et al., 2004; Chaudhry et al., 2006; Meystre et al., 2010; Vest & Gamm, 2010). For example, Blaya et al. (2010) have suggested that adoption of an effective health care information system (IS) played an instrumental role in improving efficiency when treating patients, safety of the patients under treatment, and legal compliance among other benefits. Due to the numerous benefits accrued as a result of adopting an effective IS in the healthcare, the popularity of healthcare IS has been on the rise over the recent past (Blaya et al., 2010).`

The combined value of healthcare IS benefits are seen in a reduction of medical errors and an enhanced patient safety (Berner & Moss, 2005; Braa et al., 2004; Chaudhry et al., 2006; Meystre et al., 2010; Vest & Gamm, 2010). Literature has argued how developing healthcare systems in clinical practices curbed the errors that result from wrong prescriptions, and as a result the incorrect administering of these wrong medications and/or therapies (Poon et al., 2010). With the advent of bar codes and electronic IT medical systems, the abuse on patients through wrong medications has been curbed. These improvements have caused a significant reduction in medical errors to be reduced to a point where further improvements to the system could make this tamper-proof. Further verification processes have created checks and balances critical to the safety of prescribing and administering drugs (Poon et al., 2010).

Healthcare related literature has examined the usage of IT systems in healthcare practices, focusing particularly on the benefits of using information technology in

maintaining IS in the United States (Chaudhry et al., 2006). The article established a literature review of 257 scholarly, peer-reviewed journal articles in determining the challenges of implementing and sustaining information systems within a corporation or industry. Their review has suggested that the use of healthcare IS drastically improves the quality of patient care. Guidelines were better followed because the system forces users to fully complete documentation. Furthermore, the development of computers that monitor patients' data when doctors do not have the time to do so; enabled disease surveillances that reminded patients and caregivers of necessary tests, procedures, and medication dosage increases. Thus, preventive care was found to be one of the greatest benefits of healthcare IS development. In addition, time used in documenting records and patient's history among other manual tasks was decreased through the use of IT. The benefits of healthcare IS use are many and the time that it saves also increases profits for the healthcare organizations (Chaudhry et al., 2006, pp. W-16-18).

Additional studies have noted how healthcare IS can help lower the operating costs of the various businesses affiliated with the healthcare industry. For example, according to a recent review, the main results of studies conducted substantially advocate that operating costs and other costs related to patient care could significantly lower with the use of Information Systems. Thus, the time spent in the hospital by visiting patients and by providers to operate, treat, and discharge clients has been shown to decrease with the use of IS in the healthcare field in America. These studies, while proving that developing healthcare IS saves time, did not include much data regarding how much costs were saved in detail. There were limitations based on the availability of quantitative material related to costs and savings (Chaudhry et al., 2006).

Published studies have established specific cost saving data in their study regarding healthcare information systems. The study noted another piece of raw data, showing that admission costs dropped when institutions used healthcare IS from $6,964 to $6,067 (Tierney et al., 1993). Khoury (1998) also observed Kaiser Permanente healthcare systems, and realized that the long-term costs and benefits of implementing a healthcare IS are exciting. The author noted the cost of an IS development at Kaiser Permanente was $10 million, annual expenses are $1.1 million, and in 13 years, the healthcare IS will pay itself off through savings (Chaudhry et al., 2006; Khoury, 1998).

As much as developing healthcare information systems deliver unlimited benefits, it also can carry a number of initial constraints and limitations. The following section expands on these challenges and constraints faced by healthcare IS using various detailed studies which discussed the different weakness inherited from such systems.

2.3.2. Challenges

Previously carried out studies have shown significant challenges to implementing, using, and maintaining an IS within the healthcare industries on a national level (Sung et al., 2003). Based on the literature available, a healthcare IS has many weaknesses, which raise various challenges related to healthcare IS (Charette, 2006). Some of these challenges are inherent to the nature of the system, while others arise because of the attempt to adopt a new system. As such, logistic and infrastructure challenges exist. Using a healthcare IS itself presents technology related challenges. Such as, learning how to use the IS hardware/software, and dealing with any related troubleshooting along the path. Such challenges are classified as Technical challenges (Glass, 2005; Sood et al., 2008). Other challenges are infrastructural, social, and other challenges that hinder the progress of

implementing a functional healthcare IS (Berner & Moss, 2005; Koppel & Kreda, 2010; Vest & Gamm, 2010).

A study conducted by InfoWorld in 2009 revealed that about seventy percent of the information technology (IT) projects implemented across the industry sectors are likely to fail. This failure rate has also been reported in other studies (Glass, 2005). A related study conducted by TechRepublic in 2011 indicated that more than forty percent of IS projects in the healthcare sector are abandoned, or fail to meet the anticipated business requirements, with less than forty percent of the large systems acquired from vendors being able to meet their goals (Mahmood, Asghar, & Naoreen, 2014).

A more recent report by The Standish Group indicated that only thirty five percent of IS projects implemented in the healthcare sector were completed on time, met the anticipated user requirements, and were on budget. The report concluded that out of these completed projects, only an eighth (12.5%) of them could have been considered as truly successful. According to the report, more than half of the projects overshoot the initially planned budgets and timetables yet did not deliver what was promised (Mahmood et al., 2014).

Over the years, the issue of healthcare IS failures have been reported consistently from all corners of the world. Leading organizations such as the Standish Group International Inc (Boston); Gartner, Inc (Stamford, CT); Aberdeen Group (Boston); and KPMG (Toronto) to mention but just a few, have constantly termed healthcare IS failures as a serious problem (Zineldin et al., 2014).

Many of the rampant failures of healthcare IS projects are attributed to the numerous challenges encountered while implementing IT projects in the healthcare industry. According to Lyytinen and Hirschheim (1988), challenges experienced while implementing a healthcare

IS can be grouped into four main categories: correspondence failure, interaction failure, process failure, and expectation failure. Correspondence failure refers to failure situations where design objectives and are not met, which results in system rejection by the various users. Interaction failure depends on the level of system use. Such level is measured by the amount of time spent by users on information system (regular and frequently used vs. rarely being used). On the other hand, process failure is a type of failure where Information Systems are not developed on time or within a specified budget. Lastly, expectation failure is another type of failure, which results in developing an information system that does not meet the user's (stakeholders) expectations or values (Lyytinen & Hirschheim, 1988; Yeo, 2002).

Healthcare related literature has elaborated on different ethical challenges that emerged in the healthcare industry. Previously carried out research identified numerous challenges that hindered the process of developing and maintaining the use of Information Systems (IS) in healthcare (Braa et al., 2004; Kristiina Häyrinen et al., 2008). Related studies also highlighted the slow adoption of information systems in the healthcare industry, the authors noted how many healthcare practitioners struggle to adapt IT solutions in their practices (Charette, 2006; Sun, 2012)

Charette (2006) further identified issues and challenges related to healthcare IS development. According to the author, maintaining a healthcare IS could increase in price each year. The author supported his argument by providing and comparing healthcare IS cost estimates from different countries. First, the article discussed Australia's implementation price increase from AU$500M in 2000 to AU$2B today. As well as U.K.'s implementation price increase from 2.6B pounds in 2002 to 15B pounds today. Finally, the author argued how much a healthcare IS is worth in the U.S. He also noted an implementation cost estimate

of a $100B and $150B along with a yearly recurring operating cost of $50B (Charette, 2006, p. 120). Thus, initial costs of first implementing a healthcare IS and a subsequent maintenance cost may be high, but the cost pays itself off due to the various benefits in saving the time and energy of the healthcare provider.

Another strain on the current system of healthcare is due to government participation (or lack thereof). *Current* legislation that exists in the healthcare industry also poses a challenge to the correct implementation of a healthcare IS (Berner & Moss, 2005; Charette, 2006; Meystre et al., 2010; Vest & Gamm, 2010). According to Meystre (2010), centralized systems will have to abide to the Health Insurance Portability and Accountability Act HIPAA "Safe Harbor" legislation having to do with de-identification of names, and other sensitive material, from a patient's records in order to comply with privacy laws (Meystre et al., 2010, p. 2). Thus, current laws and future laws must meet the demands of the growing population, the aging population, as well as the population of all current and prospective patients who desire efficient healthcare from their providers.

Another challenge faced by healthcare IS implementation relates to the various terminologies and different labels of Healthcare Information Systems (healthcare IS). Such as, Electronic Health Record (EHR), Electronic medical records (EMR), inter-departmental EMR, Hospital EMR, Inter-hospital EMR, Electronic patient record, computerized patient record, electronic health care record, personal health record, computerized medical record, digital medical record, clinical data repository, electronic client record, virtual EHR, and population health record (Kristiina Häyrinen et al., 2008). This presents a problem to the healthcare community in regards to setting up integrated and centralized systems, sue to the different coding, vocabulary, and classification of diseases.

Based on the literature available, healthcare IS have had many weaknesses in the past; however, substantial research on the development of healthcare IS infrastructure based on these weaknesses could lead to a meaningful and a well-functioning system (Sung et al., 2003). Therefore, it is critical to explore the factors influencing a successful IS implementation as it relates to the healthcare context. This topic is explored in greater detail in the next section.

2.4. Factors influencing successful implementation of a Healthcare IS

Successful introduction of a healthcare IS is influenced by numerous factors, which can be grouped based on various frameworks. However, in this study, factors influencing implementation of healthcare IS are categorized into six main groups, namely: 1) stakeholders' roles and responsibilities, 2) social and cultural aspects, 3) technology, 4) human capacity development, 5) participation and awareness, as well as 6) financial aspects and sustainability (Booth, 2008; Frank et al., 2012; Liu, Wang, Wang, Chen, & Jiang, 2012; Mahmood et al., 2014; San-Miguel-Ayanz et al., 2012; Schomburg, Chang, & Schomburg, 2014; Sun, 2012).

Each category comprises of a number of issues that need to be addressed for an IS to be successfully implemented in an organization. This section provides an overview of these issues based on previously carried out studies in various parts of the world. The main focus of these studies was based on the different factors identified in research conducted on hospitals in Europe and the United States of America.

2.4.1. Stakeholders' roles and responsibilities

Successful implementation of a healthcare IS depends largely on the stakeholders' roles and responsibilities in a given healthcare facility. In this context, the term 'stakeholders' refers to all persons or parties that are likely to be affected by the introduced information system and who have a direct or indirect impact on the system requirements. Stakeholders can be the development team itself, managers in a given healthcare facility, recipients of the system's output, persons who may lose their jobs as a result of the introduction of the system, and direct users of the system among many other parties (Booth, 2008).

Mahmood, Asghar, and Naoreen (2014) have investigated how stakeholders are a crucial part of a business organization who often pursue varying objectives, priorities, concerns and constraints. Therefore, the very first stage of implementing a healthcare IS in a healthcare facility should encompass handling all the stakeholders concerns and working together of the involved groups in an effort to get to a single point of view. As Mahmood and colleagues have suggested, stakeholders having different goals is a major issue that often make data management in organizations a daunting task (Mahmood et al., 2014).

According to Schomburg, Chang, and Schomburg (2014), successful implementation of IT into health programs in a given healthcare facility requires complex balancing regarding differing perspectives and concerns of various stakeholders. For example, Lin and Wang (2012) have argued how some clinicians could have been viewing new technology with suspicion, especially when they feel like the new technology is likely to challenge their professional status and autonomy, or make them lose their jobs. Patients on the other hand, are more likely to seize the potential benefits, especially when the system is likely to enhance patient care by making it more accessible. However, previously carried out studies stablished

how patients are always concerned about the security and confidentiality of their electronically stored data.

Another important type of stakeholders who are crucial to the development of a healthcare IS are the policy makers. This critical group of stakeholders is likely to be concerned with the output of the proposed system. According to Lin and Wang (2012), policy makers often require evidence to show how the proposed new technology or system could lead to benefits that outweighs the initial investment cost. All these differing views, concerns, and expectations need to be effectively addressed at the outset of any intervention involving information and communications technology. In line with this argument, Sun (2012) has noted that defining roles of each stakeholder while involving all these stakeholders as much as possible during the planning and development stages is instrumental in making the system more successful. While identifying the roles and responsibilities of the involved stakeholders represents an essential influencing factor to a successful IS implementation, another key factor that emerged from analyzing the published literature is technology. The following section elaborated on this issue using various detailed studies that discussed the different technology aspects that influenced a successful IS implementation.

2.4.2. Technology

Technology is another key category of factors that must be considered for a healthcare IS to be successfully implemented. According to Kim (2005), there is a need for a given health institution to first of all establish whether it has the required hardware, software, as well as the technical knowhow to introduce an information system that will fully meet user requirements. The study suggested identifying the required prior to the introduction of the system. The author argues how such identification could imply on that adequate assessments

that should be made to identify the readily available and useful hardware as well as any additional required parts the needed hardware for a successful IS implementation.

There is also a need for carrying out a thorough assessment of the available software. This is because one of the main concerns raised in most institutions over healthcare IS is the fact that most of them are not user friendly and lack intuitive data input. Booth (2008) suggested that an adopted system should create conformity in interface structure and design of the data irrespective of the individual's group style. There is also a need for ensuring that an adopted healthcare IS is flexible and adaptive enough. Software related issues include the language used, lack of local content creation, and irrelevance of the included content to the local situation.

According to Lin and Wang (2012), appropriate language is often neglected in healthcare IS programs. As the authors have noted, little content is available in local languages for health programs. The study further suggested that it is essential for healthcare organizations to purchase a fully functional IS, which fulfills the organization's needs from one vendor. Doing so enhances integration of health information systems and facilitates timely assessment of the patient's information from various sources at the point of care (Liu et al., 2012).

Still under the aspect of technology, there is a need for evaluating connectivity of a given Healthcare IS. Under connectivity, elements such as the available regulatory environment and telecom policy, access to electricity, power and data back-ups, solar power options, and different infrastructural elements are to be considered. Friendly regulatory frameworks and availability of the above-highlighted options increases chances of success of

the healthcare IS implemented. Service and maintenance of the system should also be considered when adopting a system as well (San-Miguel-Ayanz et al., 2012).

2.4.3. Social and cultural aspects

According to San-Miguel-Ayanz et al. (2012), there are a number of social aspects that a healthcare facility or organization need to consider first for it to effectively implement an IS. These social aspects include personal agendas, changes in status, as well as political related elements. Political issues such as conflict between the inherent values of administrators and clinicians need to be resolved for a successful implementation of a Healthcare IS.

There is also a need for examining and developing appropriate measures in order to overcome cultural issues and barriers within an institution and society that hinders an effective implementation of information communication technology (ICT). These adopted measures should focus on transforming rules and regulations surrounding telecommunication systems, as well as increasing the political will to ensure that government procedures are more transparent and to encourage information sharing in a given culture. All these elements should be taken into consideration when designing, adopting and implementing an IS not only in healthcare organizations, but in all other sectors (Booth, 2008). The author then argued how conflicting as a result of the existing organizational culture should be carefully negotiated by evaluating the possible benefits and threats of introducing an information system in a given healthcare organization. The following section introduces the different financial aspects and the role of IS sustainability in achieving a successful IS implementation, which represents another key element crucial to the system development success.

2.4.4. Financial Aspects and Sustainability

Financial viability and sustainability of the IS to be introduced in a healthcare organization is another key factor that determines its success of failure. According to a group of researchers, low financial investment in ICT in the healthcare sector is among the primary factors that lead to failure of IT projects (Schomburg et al., 2014). Low investment in the sector results in inadequate healthcare IS and IT infrastructure necessary to underpin delivery of patient care. As a result, Sun (2012) recommended the criticality of establishing a realistic financial budget for all the costs likely to be incurred while implementing an IS prior to its introduction.

Sustainability is another crucial aspect that has to be considered whenever introducing a healthcare IS, especially in local hospitals based in the developing countries. As Lin and Wang (2012) have argued, ability to financially support the introduced system both in the short-term and in the long-term is an indispensable aspect that must be considered. To achieve sustainability of a healthcare IS, there is a need for the design team to have a clear sustainability, which identifies the different costs and investments up front, as well as the ICT capacity and infrastructure requirements. A close monitoring and system evaluations are also an essential part of sustainability. Other authors added that promoting partnerships among the stakeholders at the local, national, and regional level can help in promoting sustainability of an IS (Frank et al., 2012). Another key factor emerged from the literature is the stakeholders participation during system developments. The following section further elaborated on this issue using various detailed studies.

2.4.5. Participation and awareness

Previously carried out studies have shown how the lack of active participation by the stakeholders as well as the lack of awareness are key factors that are likely to result in failure of an IS in all types of organizations. According to several authors (Schomburg et al., 2014), this issue is often contributed by lack of or inadequate capacity and training in an organization, as well as the socio-cultural issues impacting a given organization. Lack of participation and awareness usually leads the lack of understanding of changes required to accompany the innovation.

San-Miguel-Ayanz et al. (2012) established that for maximum success of an information communication technology (ICT) project to be attained, all participants must be willing to participate and perceive the introduced innovation or technology as adding value to the already existing system. In line with this finding, Li, Hsieh and Rai (2013) have established that approximately twenty five percent of ICT projects in the healthcare sector fail because people working in the health institutions where the system is introduced do not like them or support them. In order to overcome this problem, project managers should have mutual understanding of Healthcare IS amongst themselves (Frank et al., 2012).

Once this is achieved, they should introduce that understanding to all the stakeholders who are likely to be directly or indirectly affected by the adopted system. This can be achieved during the training or awareness-raising phase of the system. Sharing experiences and learning should also be encouraged to enhance understanding of the various ways people communicate, learn, and use information (Booth, 2008). On the other hand, Human capacity development is another element that cannot be overlooked when implementing a Healthcare

IS. The following section further elaborated on this last key factor which emerged from analyzing the different literature.

2.4.6. Human capacity development

Published studies highlighted the importance of having a competent and skilled ICT workforce is a crucial ingredient for effective adoption of ICT in the healthcare sector (Sun, 2012). The author argued how the workforce should comprise of highly skilled and experienced system professionals, project team leaders, and service providers. Therefore, before an introduction of IS in a healthcare institution, there is a need for identifying the available skills and the skills that need to be introduced for the system to be a success.

According to Lin and Wang (2012), training is also an essential part of capacity development that significantly determines success of failure of an IT project in an organization. Having on-going training sessions for all the involved stakeholders result in better understanding of the changes needed to accompany the introduced new technology. Healthcare IS data collection and processing, as well as information use assume a certain level of general knowledge and training among the involved health workers, which is usually not available particularly in small health units and in the developing countries.

As a result, inadequate capacity development through training that enables health personnel to acquire useful and new skills such as data collection, processing, as well as compiling statistics and graphs automatically leads to failure of the implemented system. This explains why it is crucial to always align workers' skills and knowledge with the adopted healthcare IS (Frank et al., 2012; San-Miguel-Ayanz et al., 2012).

Different authors have argued that investing in training and capacity development in content development of skills and communication increases chances of successful

implementation of a healthcare IS (Schomburg et al., 2014). Supervisor's training should also emphasize on equipping health workers with skills that can enable them teach and manage other workers. In addition, appropriate strategies and measures should be devised in order to make it possible for the less well-educated health workers to acquire the needed skills.

An examination of the above literature encountered numerous benefits from adapting a healthcare IS. Several studies have highlighted the importance of IS implementation to help systematize, examine, administer as well as make use of information in modernizing health care related activities (Bower, 2005; Kawamoto, Houlihan, Balas, & Lobach, 2005; Poon et al., 2010). On the other hand, recent studies have argued the different weaknesses found in such systems (Berner & Moss, 2005; Glass, 2005; Sood et al., 2008). Related studies investigated other critical factors, which hindered the process of implementing a successful IS in a healthcare setting (Aarts & Koppel, 2009; Kawamoto et al., 2005; Koppel & Kreda, 2010; Vest & Gamm, 2010).

While an examination of the above literature is insightful, researchers typically assume that healthcare organizations do not offer a different context from regular organizations. However, such assumptions may not be entirely appropriate, given the inherently heterogeneous nature of healthcare organizations. Reviewing healthcare related literature also enlightened the study with an abstracted view of the unusual context that healthcare professions represent (E. Davidson & Chiasson, 2005; K. Häyrinen et al., 2008; Klein, 2002; W. Li, Liu, Yang, & Yu, 2014). Consequently, this research argues for a use of new theoretical perspectives that examines the contextual elements across an organization. In particular, adapting perspectives derived from boundary spanning literature (Feldman & Orlikowski, 2011; Levina & Vaast, 2005, 2013; Orlikowski, 2002; Ulrike Schultze &

Orlikowski, 2004) as a theoretical lens could provide a fertile theoretical landscape for understanding healthcare IS implementation and use in a healthcare setting. The following section expands on the contextual aspect of healthcare, using various detailed studies that discussed the heterogeneous nature of healthcare organizations.

2.5. Contextual Aspect of Healthcare

Despite the rising popularity of IS implementation in the healthcare sector, there is an indication that a significant number of healthcare Information System Development (ISD) projects fail (Cortex, 2010). Most of factors put forward for such failures - lack of stakeholder buy-in, inadequate incorporation of diverse stakeholder perspectives, inadequate assessment of technology, and lack of usability (Booth, 2008; Frank et al., 2012; Liu et al., 2012; Mahmood et al., 2014; San-Miguel-Ayanz et al., 2012; Schomburg et al., 2014; Sun, 2012) indicate issues with deriving appropriate requirements and inadequacies in the design of such systems. These factors remain salient in the specific context of healthcare organizations, and can often be exacerbated because of the nature of the medical professional (Braa et al., 2004; K. Häyrinen et al., 2008). In addition, critical legal compliance issues related to information privacy (e.g., the Health Insurance Portability and Accountability Act (HIPAA) legislation in the United States result in adding complexity to both the design and the implementation of such systems (Meystre et al., 2010).

Moreover, the healthcare context is somewhat unusual of the unique characteristics of the Healthcare profession (Braa et al., 2004; K. Häyrinen et al., 2008). Each of the healthcare professions (e.g. doctors, nurses, pharmacologists) is bound to a distinct medical group, which extends beyond the organization (Charette, 2006). However, within the context of an organization, these diverse groups need to collaborate. Such collaboration requires efficient

boundary spanning activities (Currie & Suhomlinova, 2006), and consequently the distinct medical professionals need to develop norms and affordances for such activities (Leonardi, 2011, 2013; Markus & Silver, 2008; Zammuto, Griffith, Majchrzak, Dougherty, & Faraj, 2007) (see figure 2.1).

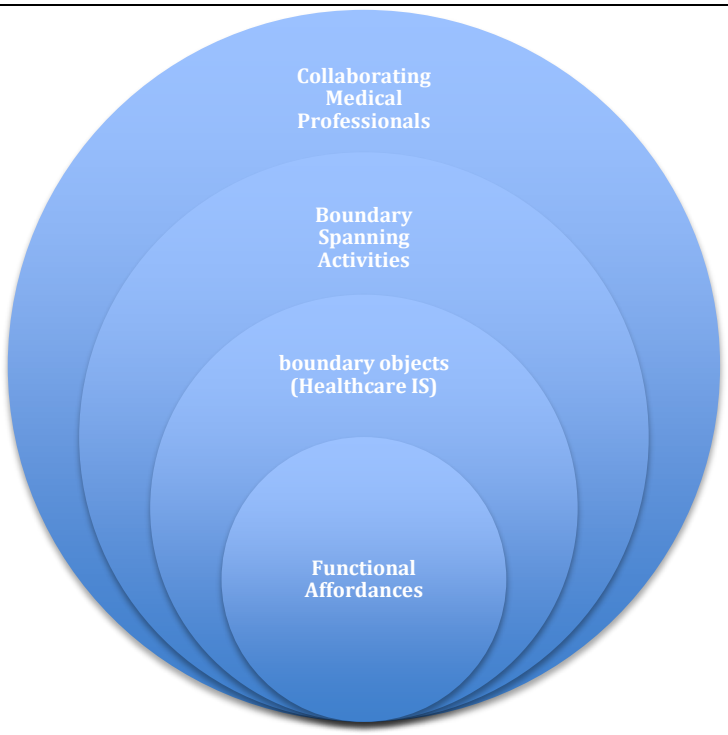

Figure 2.1 An Abstracted View of the Healthcare Context

Figure 2.1 above provides an abstracted view of IS is use in healthcare organizations. The figure summarizes the healthcare context as four stackable layers, starting from the initial ground of a healthcare context, which is represented as collaborating medical professionals (Charette, 2006). Such collaboration requires efficient boundary spanning (second layer) (Currie & Suhomlinova, 2006). Published studies have proposed the use of boundary objects to enable boundary spanning activities that facilitate collaboration among different users across boundaries (Friedman & Podolny, 1992; Levina & Vaast, 2005).

However, for such boundary objects to be effective, they need to inscribe within themselves the norms and affordances for collaboration (Leonardi, 2011, 2013; Markus & Silver, 2008; Zammuto et al., 2007) (forth layer). The following sections elaborate on each of these layers using various detailed studies.

2.6. Boundary Spanning

In the context of healthcare sector, the different medical groups (e.g. doctors, nurses, pharmacologists) are of different sizes and forms, with some hospitals having a huge group of practitioners while others having relatively small groups (Egan & Jaye, 2009; Kitson, 2009). A basic premise of this research is that the challenges faced by healthcare organizations in implementing and using an IS is contextual, and relates to the nature of such organizations. At center of such a premise is the fact that healthcare organizations are somewhat unusual of the unique characteristics of the Healthcare profession (Braa et al., 2004; K. Häyrinen et al., 2008). Published studies have established that a large section of these healthcare professions are bound to strongly defined structures and procedures that extends beyond the organization. Each of these professions has strongly defined norms, guidelines, and code of conducts that are strongly influenced by the local and global departments external to a particular organization (Charette, 2006; Kasali & Nersessian, 2015).

Consequently, work groups in healthcare organizations need to be designed keeping in mind the heterogeneous characteristics. Previously published studies established that any work process within healthcare organizations, requires extensive collaboration amongst these different medical professions, and such collaboration will necessarily comprise of significant boundary-spanning activities (i.e. communication across boundaries of the distinct groups) (Currie & Suhomlinova, 2006). Previously carried out studies have established that in such

situations, technology artifacts facilitate the collaboration by being objects that allow translation of information across the groups boundaries (or boundary objects), and such facilitation is maintained through their extensive maintenance and evolution by certain boundary spanning agents. (Bechky, 2003; Carlile, 2004; Orlikowski, 2000).

A key concept that emerged from such research is the importance of boundary spanning, which involves translating and mapping between the diverse medical groups (Levina & Vaast, 2005, 2013; Orlikowski, 2002). Given the importance of this phenomenon, theoretical perspectives from practice-based studies of boundary spanning organizations (Feldman & Orlikowski, 2011; Levina & Vaast, 2005, 2013; Ulrike Schultze & Orlikowski, 2004), were used as a lens to better understand the work process of the distinct medical groups and the nature of collaboration between them. Such theoretical perspectives helped in developing an insight into boundary spanning within healthcare organizations. The following section expands the phenomenon of boundary spanning using various detailed studies, which discussed the nature of boundary spanning objects and boundary spanning agents involved in such organizations.

2.6.1. Boundary Objects and Boundary Spanning Agents

The notion of boundary spanning has been used by IS researchers to understand the collaboration between distinct groups and the use of IS during such interaction (Levina & Vaast, 2005, 2008, 2013). Reviewing boundary spanning related literature clarified how technology is being used in boundary spanning organizations, such as healthcare (Levina & Vaast, 2005). Adapting such a perspective could provide a fertile theoretical landscape for understanding integration of IS in a healthcare setting.

Boundary spanning is facilitated through the development of technological artifacts that have the critical translation elements and affordances embedded within them. Boundary spanning literature has defined them as boundary spanning objects (Bechky, 2003; Carlile, 2004; Orlikowski, 2000). Boundary objects are defined as artifacts that span two or more boundaries across within or across an organization, and yet maintain their own identity. Maps, Forms, and prototypes are all examples of boundary objects. Further studies distinguished boundary spanning objects-in-use as boundary objects that are being utilized by different agents across an organization boundaries (Levina & Vaast, 2005).

Nonetheless, boundary objects might not participate without enforcement. Certain agent(s) must accumulate enough capital to be able influence other agents to use boundary objects (Friedman & Podolny, 1992; Levina & Vaast, 2005). There are different forms and kinds of capital such as economic (time, money, technology), social (network relations), cultural (education, expertise, position), and symbolic (prestige, honors) (Levina & Vaast, 2013; Orlikowski, 2000). Literature has classified such agents as boundary spanners (Levina & Vaast, 2005). Moreover, studies have defined boundary spanners as agents who play two or more roles across boundary spanning organizations. Such agents perform and participate in several groups. In most cases, boundary spanners usually appear when a new boundary object is enforced to an organization. For example, boundary spanners can be managers of research and development, HR Specialists, and IT professionals (Levina & Vaast, 2005).

Published studies have established that boundary spanning is achieved by agents who have the knowledge capabilities to mediate between distinct work groups (Friedman & Podolny, 1992), A key concept that emerged from such studies is the importance of boundary spanning agents (Levina & Vaast, 2005), which involves translating and mapping between

the diverse groups of an organization (Levina & Vaast, 2013; Orlikowski, 2000). Previously carried out studies have pointed out the different modes of boundary spanning. For instance, boundary-spanning activities change depending on the relations between the individuals and the objects in a shared institutional context. Boundary spanning literature labeled these as transactive and transformative (Levina & Vaast, 2013). Transactive boundary spanning involves mapping diverse groups by having boundary spanners translating such mapping. On the other hand, in transformative boundary spanning new relationships among agents are defined, and boundary spanners negotiate the meaning of such relations. Figure 2.2 below provides a comparison of the different modes from adapting Levina and Vaast's (2013) views. The figure depends on three key elements that influenced these boundary spanning modes: the agent's relations, the boundary object in use and the role of boundary spanners (Levina & Vaast, 2013).

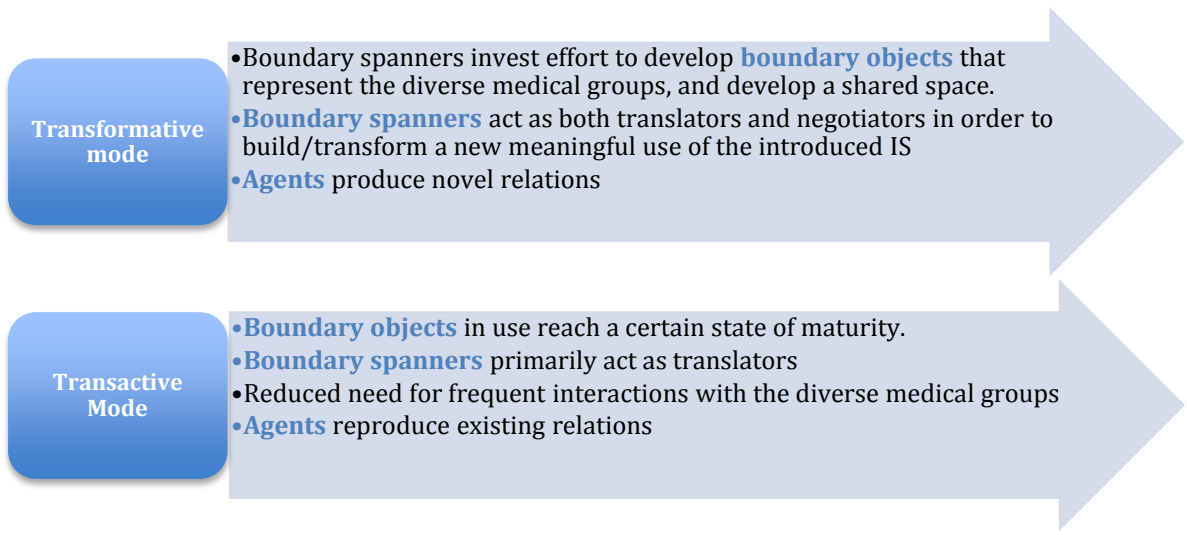

Figure 2.2 Boundary Spanning Modes

While the literature emphasized the role technology objects in facilitating the collaboration among the distinct professional groups by being technological artifacts (or boundary objects) that allow translation of information across group boundaries, such facilitation is maintained through their extensive maintenance and evolution (Bechky, 2003; Carlile, 2004; Orlikowski, 2000). Therefore, it follows that for such technology objects to be effective, they need to inscribe within themselves the norms and affordances for collaboration. The following section expands the concept of affordance using various detailed studies, which discussed the different types of affordance related to healthcare IS.

2.7. Affordance-related Literature

IS literature related to affordances has two broadly identifiable streams, one related to organizational use and adoption of IS (Leonardi, 2011, 2013; Markus & Silver, 2008; Zammuto et al., 2007). The other stream is focused within the HCI research (Hartson, 2003; Kaur, Maiden, & Sutcliffe, 1999; MacKenzie, 1992; D. Norman, 1990; D. A. Norman, 1999). The genesis of these concepts can be traced to the work of Gibson, a perceptual psychologist (Leonardi, 2011).

Gibson (1977) introduced the idea of affordances to explain the interaction between animals and their environment, and the perceptions they have of it. Gibson suggested that individuals do not interact with an object without developing perceptual idea about its usefulness, and argued that when interacting with an object, they develop a perception of the affordances provided by it rather than its qualities or attributes (Leonardi, 2011). Through the work of Norman (1990), affordances have consequently become relevant to the discussion of technology, particularly in the HCI field. Table.1 below provides an outline of representative research on affordances.

Article	Research Approach	Affordance Construct Used	Research Outcome
(Gaver, 1991)	Literature Review	IT affordances: Configuration of properties that are compatible for people's interactions, which offer a direct link between perception and action.	Suggests that the concept of affordances can provide a useful tool for user-centered analysis of technologies.
(McGrenere & Ho, 2000)	Literature Review and Survey	Affordances are nested in a hierarchy, and the levels of the hierarchy may or may not map to system functions (Degree of affordances exists relative to a particular user).	Design framework: Extends Gibson' s definition of affordances (properties that offers possibilities in the environment in relation to the action capabilities of an actor • Independent of the actor's ability to perceive. • Existence is binary (an affordance exists or it does not exist)
(Hartson, 2003)	Literature Review	1. Cognitive affordance (helps users in thinking about something) 2. Physical affordance (helps users doing something) 3. Sensory affordance: (helps users with their physical actions) 4. Functional affordance: (helps users accomplish work)	Guidelines about how these four kinds of affordance work together in contextualized HCI design.
(Markus & Silver, 2008),	Review	Functional affordances: The possibilities for goal oriented action afforded by technical objects to a specified user group (a relational aspect between an individual's objectives and technological characteristics)	Suggests that the use of an IS needs to be examined in terms of relational alignment between goals of the user and the technological attributes of a system

(Leonardi, 2011, 2013),	Empirical	Perceived Affordances: constituted through the relationship between people and the materiality of the physical objects they come into contact with (Affordances are dependent on people, and constructed in the space between human and material agencies).	• Perceptions of constraint lead people to change their technologies • Perceptions of affordance lead people to change their routines.
(Sarker, Chakraborty, Tansuhaj, Mulder, & Dogerlioglu-Demir, 2013)	Empirical	Identification of specific functional design affordances, which facilitates interaction during the mail order brides (MOB) process. These are	The research proposes a process model of user interactions in the context of MOB process, and uses affordances to identify how MOB websites facilitate the interaction during the different process states.
(Chatterjee, Moody, Lowry, Chakraborty, & Hardin, 2015)	A cross-organizational survey	The authors examine three different affordances: 1. Collaborative IT affordance (allows individuals to work and integrate each other's knowledge) 2. Organizational memory affordance (the ability of IT to create, store, transform and exploit organizational knowledge) 3. Process management affordance (the allowance provided by IT to design, and monitor work processes)	IT affordances positively influence organizational virtues, which then influence organizational improvisational capabilities, thus improving organizational innovation.

Table 1 Affordance Related Research

Norman's formulation of the concept suggested that affordances are intrinsic properties of technological artifacts that provide users with cues for a proper use of that technological artifact (D. A. Norman, 1999). He also defines the role of design as something

that makes such affordances easily perceptible to a potential user (Leonardi, 2011). Such a conceptualization while based on Gibson's idea about affordances has a certain distinction from it. In fact, Leonardi's (2011) excellent discussion of the genesis of this construct, suggested that "Norman's arguments are a bit different than Gibson's in that he claims that affordances do not change across different contexts of use; rather, they are always waiting to be perceived (Leonardi, 2011, p. 153). In any case, Norman's motivation in examining interface characteristics and their potential usefulness in terms of affordances has found considerable resonance in HCI research. Such research has attempted to use the concept of affordance to understand the attributes of system design features, and to understand what these features offer to the user (Gaver, 1991; Hartson, 2003; McGrenere & Ho, 2000).

An outcome of such studies has been a classification of the different kinds of affordances, such as cognitive, physical, sensory, and functional affordances. Cognitive affordance is defined as a design feature that facilitates and helps the user in thinking or knowing about something (e.g., words in a button and writing the word push on a door) (Hartson, 2003). Physical affordance, or real affordance is defined as a design feature that facilitates and helps the user doing something (Hartson, 2003; D. A. Norman, 1999). For example, an adequate size and easy to locate are both physical affordances of a click button design. Sensory affordance on the other hand plays a supporting role by helping the user with his/her physical actions (e.g., a label font size large enough to read easily) (Hartson, 2003). Such types of affordances are often referred to as implied affordance (Gibson, 1977; D. A. Norman, 1999), or as the perceptibility of an affordance (Gaver, 1991; McGrenere & Ho, 2000). Lastly, functional affordance is conceptualized as a design feature that helps the users accomplish work; in other words, it is the usefulness of system functionality. For example, a

functional affordance can be the ability to sort a series of number by having a sort button to click on. However, one should note here that affordances represent not just the feature of the system, but its potentiality of being usable to the user. Hence, the existence of these different types of affordances provide users with a sense about the potential of the technological object, and provide certain conditions for its appropriation (Hartson, 2003).

Another stream of research has extensively used the concept of affordance within an organizational context of IS use and its implications. This stream of research splits the difference between the conceptualization of Gibson and Norman, and emphasizes a relational aspect between an individual's objectives and technological characteristics (e.g. Hutchby, 2001; Markus & Silver, 2008). Specifically, such a view suggests that affordances do not represent properties of either the material aspect of technology or the social aspect related to an individual; instead, they are constituted through the relationship between people and the materiality of the physical objects (e.g. technology) they come into contact with (Leonardi, 2011). A consequence of this formulation is the assertion that while technology attributes may exist independent of people; affordances are intrinsically tied to the context of its use (Hutchby, 2001; Markus & Silver, 2008).

As suggested earlier, this research argues that affordances provide an intriguing. Another argument that emerged from examining the published literature is how affordances are potentially useful in exploring the linkages between needs of collaborative interactions within a healthcare organization and capabilities of an IS designed to facilitate such a collaboration. However, this dissertation adopts a middle ground between the conceptualization of affordances in HCI and the organizational IS research. While the study accepts the notion of contextual variance in perceptions of affordances, the researcher retains

a conviction that such affordances can be “designed-in” within a particular broad context of the use of technology (e.g. healthcare organizations). In addition, the research formally focuses on the idea of functional affordances, which represent a relationship between a technology object and a specified user that “identifies what the user may be able to do with the object, given the user’s capabilities and goals” (Markus & Silver, 2008, p. 622).

2.8. Chapter Summary

This chapter presented an overview of the extant available literature relevant to healthcare information systems. Based on the literature analysis carried out, there has been extensive research about Information Systems (IS) implementation and use in the healthcare sector (Blaya et al., 2010). A theme that emerged from this research is such organizational IS is critical to a healthcare organization for reasons of efficiency, safety of its patients, better treatment, and also for legal compliance (Berner & Moss, 2005; Braa et al., 2004; Chaudhry et al., 2006; Meystre et al., 2010; Vest & Gamm, 2010). A similarly pervasive theme is that of challenges to their implementation and adoption (Berner & Moss, 2005; Sood et al., 2008). The main challenges identified in this chapter include hardware related challenges, cost barrier of setting up the physical components of a system, and technical challenges. Additional studies also argued how healthcare information systems have had many weaknesses in the past and failed; however, substantial research and development of healthcare IS infrastructure based on these weaknesses could lead to a meaningful and well-functioning system (Sung et al., 2003).

Therefore, it was critical to explore the factors influencing a successful IS implementation as it relates to the healthcare context. Previously carried out research have established a number of categories that comprises a number of issues that needed to be

addressed, for an IS to be successfully implemented in an organization. Such as, the stakeholders' roles and responsibilities, social and cultural aspects, technology, human capacity development, participation and awareness, as well as financial aspects and sustainability.

A basic premise of this research is that the challenges faced by healthcare organizations in implementing and using a healthcare IS is contextual. In this regard, literature related to the context of healthcare organizations, including a brief background of the significant amount of boundary spanning activities found in healthcare organizations has been carefully analyzed. In particular, boundary spanning literature emphasized on the role of boundary objects in enabling boundary spanning activities within and across an organization's boundaries (Carlile, 2004; Levina & Vaast, 2005, 2013). Moreover, additional research highlighted the critical role of boundary spanning agents in facilitating collaboration among distinct medical groups (e.g., doctors, nurses, pharmacy) (Friedman & Podolny, 1992; Levina & Vaast, 2005, 2013).

Published studies have also highlighted that such boundary objects need to inscribe within themselves the affordances and the norms for a successful collaboration and interaction of different users across an organizational boundaries (Hutchby, 2001; Leonardi, 2011). This dissertation argues that the identification of such affordances could serve as a step towards a possible conceptual foundation for developing a more meaningful IS in a healthcare setting. The following chapter explains the use of the different theoretical perspectives identified from reviewing the published literature and their implications to this dissertation, beginning with a descriptive narrative of the methodological approach used to conduct this research.

3. RESEARCH METHOD

This dissertation adopted an interpretive case study approach in conducting the empirical study by following guidelines from Walsham (1995, 2006). As mentioned in chapter one, the research objective was to develop an insight into the nature and design of healthcare IS.

While many researchers in the healthcare discipline focused on examining the technical functionalities and usability of IS (Berner & Moss, 2005; Chaudhry et al., 2006; Meystre et al., 2010; Vest & Gamm, 2010), limited studies explore the detailed features and functionalities of healthcare IS in terms of interface design. Therefore, this research is inherently exploratory, and therefore case research suggests itself as an appropriate research method (Walsham, 1995; Yin, 1994). Adapting this approach allowed an in-depth examination of the healthcare IS by identifying key factors of interface design characteristics representing functional affordances, and the boundary spanning role played by the IT team in developing a meaningful IS. This chapter presents the particulars of the case study approach used for this dissertation, starting with a detailed description of the research design approach.

3.1. Research Design and Rationale

Interpretive Case Studies are observations on societies in which the results are translated by the researcher. Such studies are conducted to increase knowledge of a certain phenomenon from interpreting people's actions and reactions to documents and artifacts (Walsham, 1995, 2006). Published literature recommends adopting an interpretive case study approach to increase knowledge about the steps that it will take to develop a functional healthcare IS (Walsham, 1995).

According to Walsham (1995), a way to explain this type of study method is to imagine a building's scaffolding that is taken off once the building has been constructed (p. 76). Thus, interpretive studies observe the foundation of the phenomenon, based on the experiences of those who experience the ramifications of the issue at hand. In addition to being a process within itself, the observations that the researcher completed on the field have greatly contributed to the interpretations that accomplished the final results of the study. Thus, the researcher's views are integral to the finalization of the case study (Walsham, 1995).

The purpose of this study is to identify and examine the nature of a healthcare IS design. Therefore, the interpretive case study is an appropriate approach to deliver suitable reports. This research design is also appropriate for this dissertation since interviews are used to examine issues such as those related to the use of IS (Walsham, 1995).

This research utilized different forms of data sources, such as the health care information systems and the different equipment used to access the healthcare IS (computers, IPADs), and different documents that were circulated within the hospital regarding the use of the healthcare IS (e.g., memos and flyers (Creswell & Clark, 2007; Yin, 1994). Last but not least, the primary source of this study was interviews. In particular, for the interview design, open-ended items allowed participants to answer questions in a more complete manner. This approach enabled the potential to reveal additional information that was not anticipated by the researcher (Walsham, 1995, 2006). Drawing on this approach resulted in conducting a second and a third round of data collection. Thus, an interview protocol was designed and re-designed to answer the two research questions stated in chapter one, as well as to address the objective of the study.

Different scholars also highlight the different data collection methods in qualitative research, such as, direct observations, in depth interviews, and document analysis (Yin, 1994). Therefore, in addition to conducting semi-structured interviews on healthcare personnel other data collection methods were also used in this dissertation (Creswell & Clark, 2007). Such as, taking field notes of participant's reactions of the system use, as well as the participant's impressions were all recorded and noted. Notes of personal interactions with the healthcare IS in use and the hospital the collaborative environment were noted as well.

Moreover, different forms of text-based material were collected to support the final interpretation for the data, such as flyers, media reports, and screenshots of the current healthcare IS of the hospital. In addition to the collected literature, the researcher was responsible to collect enough field notes about the system trial that was provided by the hospital. The system trial included an overall run through of the healthcare system used in the hospital. Different types of field notes were taken regarding the system design and use (Creswell & Clark, 2007). Due to the researcher's capability of observing processes related to current healthcare protocol, the design study was meaningful and in-depth.

3.2. Role of the Researcher

The researcher played the role of the main instrument of the data collection process and personally conducting individual interviews and recording them after participant's approval (Walsham, 2006). Field notes and memos were recorded while meeting the different participants (Walsham, 1995, 2006; Yin, 1994). As the interviews were conducted, the researcher encouraged the participants to elaborate on the subject matter to gain a detailed and descriptive narrative. Participants were informed that they may ask question at any time during the interview, and they were constantly reminded and asked if they have any

additional input or comments (Yin, 1994). This approach allowed the participant to answer in a more complete way, as well as it revealed additional information that the study did not consider at first (Creswell & Clark, 2007; Walsham, 1995, 2006).

Observations were another key element of the researcher role. The researcher was able to observe how workers perform on the field and interact with the healthcare IS in use (Yin, 1994). The researcher also had a role on evaluating the healthcare IS by having a feel on the nature of the healthcare IS use within the hospital (Creswell & Clark, 2007). The researcher played a role in taking field notes and making interpretations of the healthcare IS functionalities and design (Creswell & Clark, 2007), as accessibility and a system walkthroughs were granted while being supervised. Given the criticality of these multiple sources of data collection, the researcher made sure to pay careful attention-to-detail in recording and gathering evidence to support the final interpretation through personal observation and key observers' analysis of the situation (Creswell & Clark, 2007; Walsham, 1995, 2006).

3.3. Data Collection

In order to develop an in-depth understanding into the nature and design of healthcare IS, this research utilizes several sources of information to capture such subjective experience. During the interview process, observations regarding daily protocol were conducted. Also, interviews with medical personnel, and technology personnel were pursued. The gathering of information from the chosen hospital yielded a plethora of information about the current state of the development and use of the healthcare IS.

The research study is based at a government hospital in the capital of Saudi Arabia, Riyadh city. Through the use of this hospital, general knowledge from current medical

professionals were examined. The case study was dependent on the men and women who offer their experience and information regarding their use of the healthcare system within the hospital. Weaknesses and strengths were also reported in this case study.

3.3.1. Site

The site for data collection is a government hospital located in the capital of Saudi Arabia, Riyadh, King Faisal Specialist Hospital and Research Centre (KFSH&RC). The hospital was established in 1975, and it runs a 936- bed tertiary care facility. Moreover, the total personnel of the hospital are 6,946 (KFSH & RC, 2013). This hospital was selected for the study because it fits the case description, as it was one of the first hospitals in the Middle East to be recognized by the Health Information and Management System Society (HIMSS) as a stage six for its system adoption (HIMSS & Analytics, 2014). This indicates a high level of integration of IS within the organization, as only 27 percent of the hospitals in the United States have achieved a stage three or higher, and less than one percent from the hospitals achieved a level six. The researcher believes that this makes the selected organization an appropriate site for the research endeavors.

3.3.2. Data-Collection Site and Procedures

The study population is university and hospital directors or other officials who are involved in the use of the current healthcare IS or have knowledge of these systems from a government university hospital in Saudi Arabia. The study sample included 42 males and females chosen from those who have been referred by their directors or chairmen's. All participants agreed to participate in the study and were informed of the following:

1. The participation was voluntary.
2. The participants were allowed to ask questions at any time (during the interview, or after the interview).
3. The participant could withdraw from the study at any time.

Prior starting the data collection procedure, the researcher fist applied for an approval for an institutional review board (IRB) in order to conduct a research involving the use of human participants. A copy of the IRB approval is provided in the Appendices section of this dissertation, labeled as Appendix A. The researcher then contacted the healthcare organization directors from a contact list in June 2013, December 2014, and May 2015. Several personal meetings were held requesting approval and assistance in recruiting participants from the hospital site. Approval was granted from the director and hospital accessibility was provided. A copy of the hospital approval is provided in the Appendices section of this dissertation, labeled as Appendix B. In addition to requiring every participant to sign the consent form, the researcher provided the director with a recruitment letter to be given to the participants on his behalf. The recruitment letter explained the purpose of the study inviting employees to participate in this beneficial research (See Appendix C and D).

Initially, the researcher obtained a list of people that should be interviewed based on knowledge or awareness of the need for the healthcare IS. The criteria for the selection included:

1. The participants must have been working in the hospital.
2. The participants belonged to any of the following departments of the organization: (Doctors, Nursing Unit, Pharmacy, and IT department).

3. The participants used the healthcare IS to carry out their daily professional workflow.
4. The participants were knowledgeable and aware of the healthcare IS in the hospital.

All participants were recruited on a volunteer basis according to availability. This convenience sample was chosen since there are appropriate participants to choose from, locally. The researcher contacted potential participants from this list via email and telephone, regarding study participation. Those interested were instructed to meet at a specific time at the work site. The researcher met with the participants at the designated time and place where the participant signed a letter of consent, and was briefed about the study.

Qualitative data for the study was collected from forty-two interviews of healthcare professionals. The semi-structured interviews were conducted on doctors, pharmacists, IT personnel and nurses; these healthcare personnel were able to divulge personal case stories that helped the researcher formulate a final interpretation of the situation.

The researcher was able to understand the nature of the collaboration amongst the different doctors, nurses, pharmacists and IT personnel in their work place, as the interviews were conducted in the hospital during working hours. The researcher was also able to evaluate the use of the healthcare IS (ICIS) by the doctors, nurses, and pharmacists during the interview as well. Field notes regarding the events that occurred during the interview, such as a medication requests and blood test orders were all recorded and interpreted at the end of each interview.

On the other hand, the researcher interviewed the IS developers to gain a better understanding regarding the development and implementation of the ICIS system. The IT

developers provided some very helpful information and different case stories about the different approaches they took to design and customize the system. For example, they explained the different initiatives they had to preform in order to develop this successful healthcare IS, such as creating committee teams, and the mandatory workshops they performed on all the system users. The IT developer's input enlightened the researcher about the past system used in the hospital, as well as the different development stages the current system went through. Table 2 below summarizes the profile of the respondents involved in this dissertation.

Department	**Number of interviewees**	**Position**	**Follow-up visits**	**Access to Field**
IT Department	9	Senior System Developer IT Specialist IT Assistant	Yes	Transcribed Interviews Field observation Note taking System run through Online System Training
Doctor	11	Attending Surgeons Fellows Residents Interns	Yes	
Nurse	16	Head Nurse Nurse ` Nutrition Specialists	Yes	
Pharmacy	6	Head Senior Assistant	No	

Table 2 Data Collection Sample

The semi-structured interviews included open-ended questions related to the nature of system design, use, as well as the user's daily workflow and interaction with the hospital IS (see table 3 in the next page). Within this structure, the interviewer encouraged the respondents to elaborate on personal experience, provide examples, and express their perceptions about the system. These open-ended items allowed the participants to answer questions in a more complete manner; it also revealed additional information that were not anticipated at first. Most of the interviews ranged between 30-50 minutes, and were tape-recorded then transcribed. The interview protocol was designed to answer the main research questions of the study.

After concluding the interview from each participant, the researcher manually typed the interview data from the recording device used into a word document. Participants were offered the option to retrieve a copy of the interview transcript via e-mail in a one month's time after the holding of the interview. Additionally, some of the interviewees were more comfortable answering the interview questions in their native language (Arabic). Given the fact that the researcher's first language is Arabic, the researcher was able to conduct the interview in their preferred language. However, very few of the interviews included Arabic to English translations at the time of transcribing the data.

Interview Questions	
Doctor/Nurse/pharmacy	• Could you lead me through how the system helps you with your day-to-day work activity? • If you examine the use of the system critically, what issues/inconveniences can think of? • When and how do you interact with other users (IT, nurses, pharmacy)? What features do you use to complete this task? • Would you comment on the role of the system in allowing this collaboration? Is it beneficial? • What feature in the system is the most critical? Mostly used? • (Doctor/Nurse): What features and tools do you use during your interaction with the patient? • (Doctor/Nurse): Do you use any features or tools before or after interacting with a patient?
IT Department	• Could you describe the system that is used in this hospital? When was it introduced and how was it designed and adapted? • Did you work on an older system prior to ICIS installation? How is it different? • Do you often have to change certain functionalities or features of the system? What is the process of maintaining a well-developed system? • Describe your typical system related interactions with the doctors/nurses/pharmacists • What was the nature of the training you provided to the hospital personnel? • If you examine the use of the system critically, what issues/inconveniences can you think of? • Are there any future plans or initiatives?

Table 3 Interview Questions

During the interview, the researcher took extensive notes about impressions from each participant including body gestures, head nods, and tone of voice. The participants showed many emotions, such as feeling frustrated about certain issues to showing happiness about certain functionalities in the system. Participants were comfortable enough to ask

questions for clarification at any time during the interview. Overall, all of the participants were very respectful and cooperative in providing the needed information to complete the study.

3.3.3. *Personal Observation and Opportunities*

Following Creswell and Clark's (2007) approach, in addition to interviews, documentation were collected that ranged from recent legal reports to media literature. Direct observation, as a part of the interpretive design is important in analyzing details in the field; also, physical items such as tools and devices that help or hinder the progress of IT in the medical field in Saudi Arabia were recorded and observed by the researcher (Creswell & Clark, 2007). Therefore, the data collection design involved paying attention-to-detail in recording and gathering evidence to support the final interpretation through personal observation and key observers' analysis of the situation in Saudi Arabia.

In particular, during the interview process, the researcher was able to observe the daily protocol and the nature of system use within the hospital. For example, while on field, the researcher was able to observe interactions between the different healthcare professionals (e.g. doctors, nurses, pharmacists), as well as the actual use of the healthcare IS, and how the overall work flowed through the hospital.

Limited exposure to the actual system in use was also granted. In addition of having an opportunity of a guided walkthrough of the healthcare IS interface, the researcher was also very privileged to have access to the simulation system used for mandatory training workshops conducted in the hospital. The IS accessibility allowed the researcher with the capability to examine the interfaces of the healthcare IS in use, and examine the nature and

implication of its design at a very general level. Figure 3.1 below provides a sense of the hospital's healthcare IS user interface that is currently running in KFSH&RC.

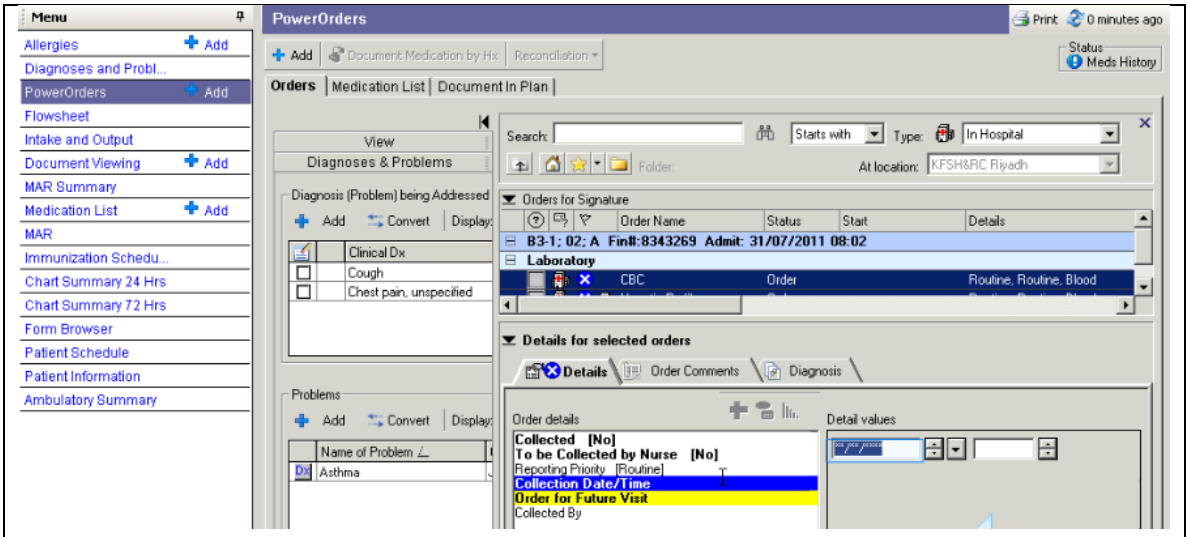

Figure 3.1 Hospital IS User-Interface

The collected data included interviews, the overall notes after the interview, field notes of site observations about the healthcare IS, and different literature in the form flyers and handouts that were routinely circulated within the organization. The researcher then cross-referenced the patterns that emerged from the interview participants, with these different collected data to confirm or reject the findings and expose any inconsistencies (Creswell & Clark, 2007).

As the analysis of the collected data proceeded, several gaps were found in the collected records. The research sought a new round of relevant data that is consistent with the principles guiding the analysis (the following section further elaborates on this). Consequently, the study conducted multiple rounds of data-collection throughout the analysis

procedures. Follow-up emails were also sent and several conference calls were held as needed. However, these follow-ups were only placed to clarify some data inconsistencies. Figure 3.2 below provides a timetable of these multiple rounds of data collection. The next section further explains the elaboration on the analysis approach and assumptions underlying it.

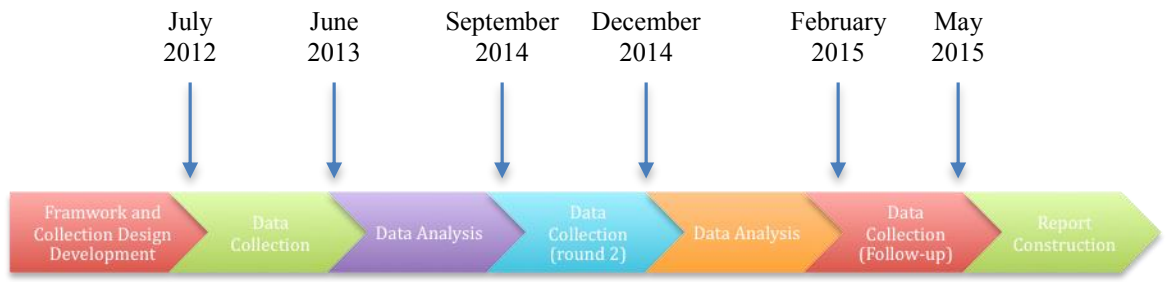

Figure 3.2 Study Timetable Work-plan

3.4. Data Analysis

This research used grounded theory method (GTM) (J. Corbin & Strauss, 2008; Glaser & Strauss, 1971) analytic procedures as a guide for data analysis (Strauss & Corbin, 1990). The analysis process was initially done individually, and then discussed and re-interpreted through numerous combined sessions with the researcher's academic advisor. During the analysis, the availability of the multiple sources were instrumental in helping building up insights about the different aspects of the development and use of the information system. For example, the interviewees had extensive experience on the Integrated Clinical Information System (ICIS), and provided a rich text narrative related to the nature of system use, perceptions about the system, tactics and strategies used to develop a useful system and

maintain it. The opportunity to explore the actual system in use (and its training simulation version) helped develop a narrative view of the system and the specific contexts of its use. Finally, the different literature related to the system helped develop an insight into the manner in which the hospital's IT department, advocated and facilitated the use of the healthcare IS.

The use of GTM procedures within an interpretive case study framework is not unusual, and has precedence in existing research (e.g (Lehmann, 2001; Maznevski & Chudoba, 2000; Urquhart, 2007). Extensive studies highlight the effective use of GTM, and suggest using its helpful analytical procedures within qualitative studies (Lehmann, 2001; Urquhart, 2007). Therefore, this research borrowed GTM tools and techniques as a guide for the data analysis (Strauss & Corbin, 1990). Not only did adopting such tools help in framing and conceptualizing the assumptions of the analyzed data, but the researcher believes that applying GTM techniques also revealed some hidden meanings of the collected data during the data analysis (Urquhart, 2007). Figure 3.3 provides a general view about the research framework process used to conduct this study.

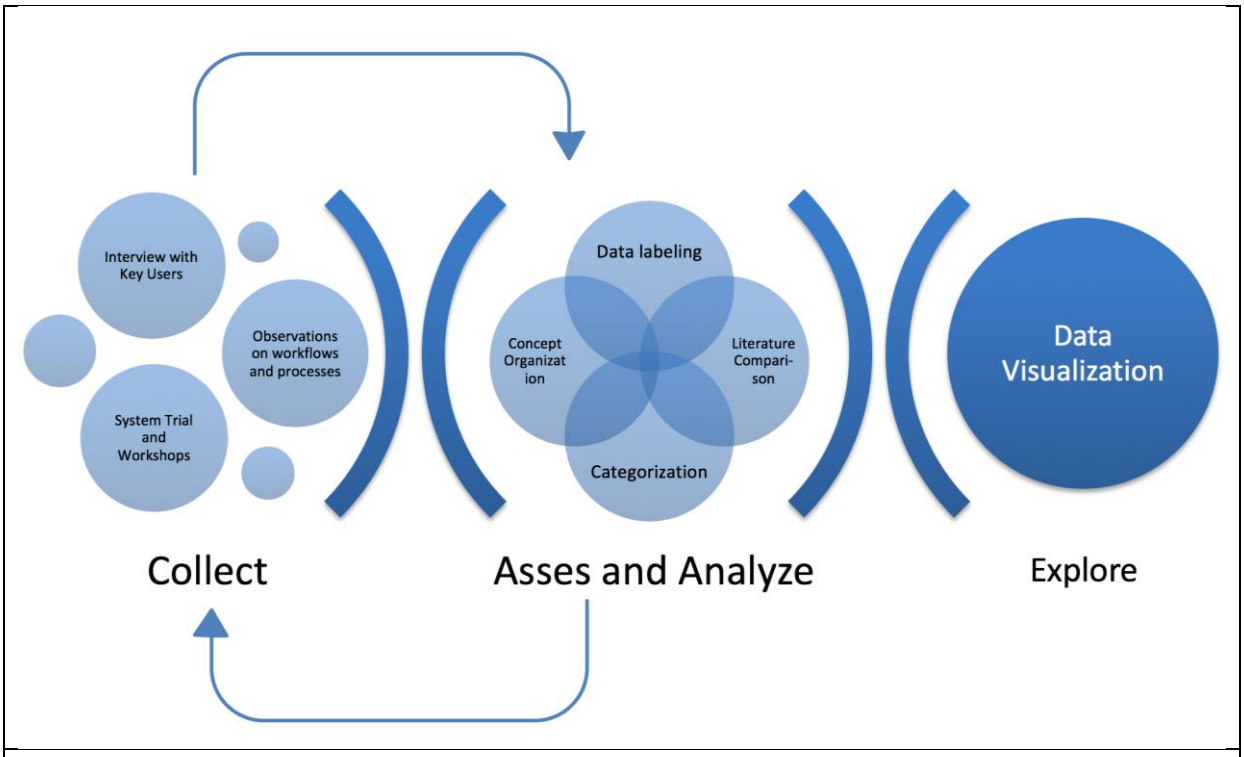

Figure 3.3 Data Analysis Process

3.4.1. *Data analysis Techniques and Procedures:*

GTM is a useful technique, because it allows for the development of theoretical formulations grounded in data. This study followed Strauss and Corbin's overall approach of conducting a qualitative study using GTM procedures. Their techniques are primarily inductive, and the procedure entails three hierarchical stages of coding - open coding, axial coding, and selective coding (J. Corbin & Strauss, 2008; Strauss & Corbin, 1990).

The first phase of open coding involved fracturing and labeling the transcribed interviews by identifying themes, assigning codes and writing memos (Sarker, Lau, & Sahay, 2000). The data analysis in this phase was done through two stages; First, the researcher interpreted the data, the second stage involved modifying these interpretations through recurring meetings with the researcher's academic advisor, which included multiple iterations of conceptualization and re-interpretations of the collected data. The interviewees

had extensive experience about the healthcare IS (ICIS) in the hospital. They also divulged personal case stories that helped the researcher better understand the phenomenon in hand. Illustrations of this phase of the analysis are provided in table 8 in Appendix E.

The repeated run-throughs on the data and codes led to the emergence of additional concepts and some higher-level categories through the identification of the themes and codes that seems to recur in several interview findings. Subsequent to this step, the researcher conducted a second round of coding aimed at identifying patterns of theoretical aggregation, interpreting them and developing linkages between them. Figure 3.4 below provides an example of the category clusters developed in the open coding phase.

Figure 3.4 Open Coding: Developing Category Clusters

Next, the analysis matured to the axial coding phase of GTM on the empirical data. The objective of this phase was to develop a better understanding about the relationship or linkages between the discovered concepts identified in the previous phase. During this phase

intensive examination of the emerged categories and themes from the codes and notes identified in open coding were conducted. The search on the collected data for patterns, and the examination of the connections between the themes and their meanings allowed the researcher to develop a hierarchy of the defined categories. The researcher then went back to the raw data to confirm certain linkage between the different categories, which in some cases led to the emergence of new codes. The identification of the linkages allowed the researcher to reach to conclusions about the different patterns of the concepts that were critical to the study's theoretical narrative. Developing these theoretical fragments were the first building blocks of the theory development (see figure 3.5).

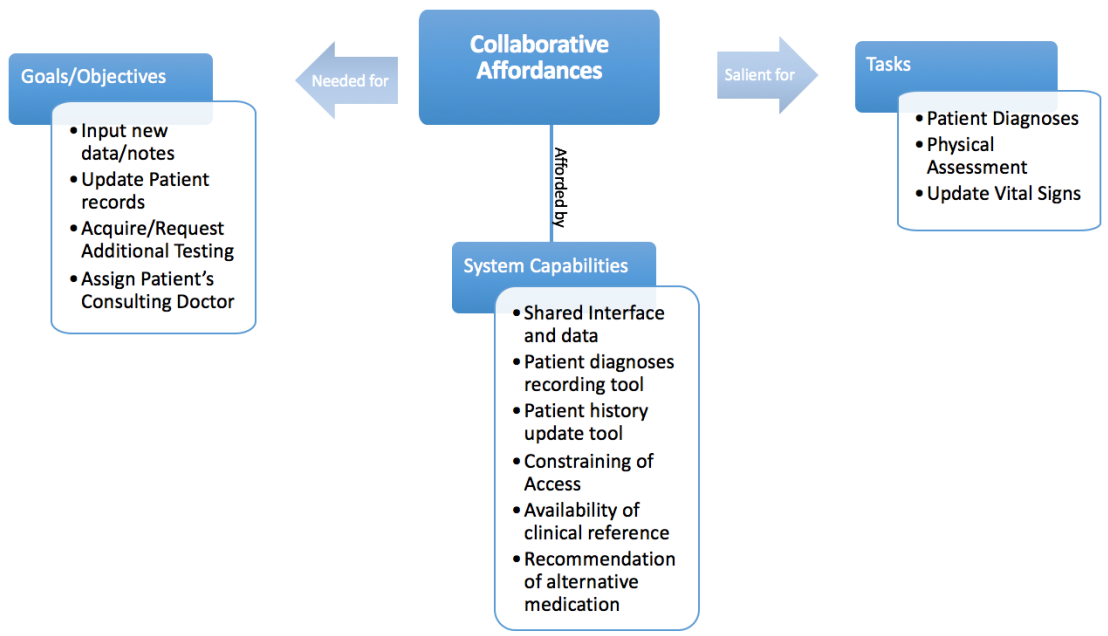

Figure 3.5 Axial Coding: Developing linkages between categories

The selective coding phase involved identifying the two core categories, which in this case were "functional affordances", and "Role of IT". The researcher started developing integrated narratives based around this category, highlighting its relationship with other key

categories. The memos and hierarchal structures that emerged from the axial coding phase were the starting points to the selective coding phase.

Constant comparisons and sensitivity developed from existing literature, as well as the researcher experience remained an integral part of the analysis procedure. Constant comparisons were particularly useful in the development of concepts and categories during the open coding phase. However, data comparisons were instrumental in the development of category relationships (axial coding), and the integrative memos during selective coding. Furthermore, theoretical sensitivity derived from existing research was useful in enriching the research, as well as clarifying the implications of the collected data. In summary, the process of the data analysis procedures involved several steps. Table 4 below summarizes the step-by-step of the GTM process as the authors explained in their article (Sarker et al., 2000).

	Step	**Description**
1st	Label the data	Read the transcribed interview data and identify basic themes or meanings in each document (labeling the data)
2nd	Organize concepts	Examine the transcribed interview data as a group, coding those themes or meanings that seem to recur in several interview findings.
3rd	Develop a hierarchy of categories	Search the data for patterns, or connections, between the themes and meanings.
4th	Link Categories	Draw conclusions based on these patterns of themes and meanings as related to the research questions.
5th	Compare with the literature review	Compare findings to preexisting knowledge from the literature review.

Table 4 Adopted GTM Analysis Producers

Applying the Grounded Theory Method (GTM) on the interpretive case study approach rewarded the study with greater and richer results. Nonetheless, this dissertation

adapts related theoretical perspectives for a better interpretation of the collected data in addition to applying GTM procedures on the study. The next section elaborates on the nature of the different theoretical perspectives and how they were applied.

3.5. Theoretical Sensitivity

As is frequently the case in interpretive research, theoretical perspectives from related IS research helped in framing as well as interpreting the data. Existing theoretical perspectives play an important role in interpretive analysis, particularly in allowing the researcher to make sense of data (Walsham, 1995, 2006). Consequently, the researcher looked into the literature to develop a better understanding about the use of healthcare IS in a healthcare setting. GTM techniques recommend developing theoretical sensitivity in the process of formulating an empirical theory. This analytical technique highlights the importance of constantly comparing and drawing on theoretical perspective from existing literature, particularly during the data analysis of the research (Strauss & Corbin, 1990). This section elaborates on the different theoretical frameworks that derived this study, starting with an overview of how boundary-spanning perspectives helped in analyzing the collected data.

Research on collaboration amongst diverse work groups across an organizational boundaries and the consequent boundary spanning activities (Levina & Vaast, 2005) provided the study with analytical tools to examine the interactions between the healthcare professionals (e.g., doctors, nurses, pharmacists, IT personnel), and the use of IS during such interaction. First, this perspective allowed the capability to keep the distinct individual groups within a hospital analytically salient in making sense of the researcher's observation and collected data. Second, such theoretical perspectives (Feldman & Orlikowski, 2011;

Levina & Vaast, 2005; Ulrike Schultze & Orlikowski, 2004), were used as a lens to better understand the work processes of the different groups and collaboration between them. Drawing on the concept of boundary spanning (Carlile, 2004; Orlikowski, 2002), allowed the researcher to understand how different healthcare professionals collaborate in boundary spanning organizations, such as a healthcare organization.

The final piece to the theoretical sensitivity important to this analysis was the concept of functional affordances (D. A. Norman, 1999). The concept of functional affordances sensitized the study to a possible relationship between the user goals and the technology characteristics provided by the healthcare IS. Drawing on this concept provided the researcher with the appropriate theoretical lens to frame the nature of the interface design characteristics regarding the healthcare IS (Gibson, 1977; Leonardi, 2011). In particular for this research, the concept of functional affordances (Markus & Silver, 2008) sensitized the study to a possible relationship between the technology characteristics provided by the healthcare IS and the different goals of individual actors within the hospital's workflow (Leonardi, 2011).

However, the exploration of data using the theoretical lens of functional affordance was iterative and linked to the outcomes of the multiple rounds of data analysis. The researcher has been mindful in using such theoretical perspectives, and did not violate the central premises underlying GTM based analysis. Specifically, the research team attempted to ensure that pre-existing theory was not forced on the data for the purpose of proving or disproving it, as this would be against the spirit of any GTM variant (Suddaby, 2006). For example, while the concept of functional affordance sensitized the study to a possible relationship between the task related goals and technology features, the specifics of the

relationships and the actual nature of the perceived functional affordances emerged from the collected data, were not forced by pre-existing theoretical perspectives.

In conclusion, empirical investigations could expand healthcare IS digitization and increase its usability and efficiency (E. Davidson & Chiasson, 2005; K. Häyrinen et al., 2008; W. Li et al., 2014; Timmermans & Berg, 1997). Throughout the course of the study, political and social barriers that affected a smooth digitization of the healthcare IS were recorded in documentation as much as possible—adhering to Walsham's explanation (Walsham, 1995, 2006) on related case studies. Furthermore, infrastructural weaknesses in the current program were interpreted through interviews with clinical user of a government hospital in Saudi Arabia. The next section further elaborates on the theoretical interpretations gained from conducting this research, by providing a detailed description of the case.

3.6. Case Description

The case focuses on the implementation and use of Integrated Clinical Information System (ICIS), a Healthcare IS at KSFHS&RC. This system is a result of efforts over the past decade within the hospital, as it was launched in 2007 and has been in use since then. The system includes the different aspects related to the hospital, such as scheduling management, laboratory and radiology information systems, pharmacy, emergency department, medical records, nurse documentation, and physician order entry (CPOE) (AlSekait, Chakraborty, & Chatterjee, 2015; KFSH&RC, 2013). Consequentially, the system was originally envisioned as a system that securely interconnects the different hospital information systems into one integrated system.

As a respondent doctor mentions:

"the older system was very basic"

Other users indicate:

"We had a system for the lab and a seprate system for the nurse department", "Other programs were used like powercharts and excel sheets for generating reports"

The implemented system has been successfully adopted and continues to be adapted to meet changing needs, ICIS is a source of pride within the hospital, as one doctor mentions:

"King Faisal Hospital is the first hospital in Saudi to implement a well developed system", "the hospital is very active and invested in advancing and developing a state of the art system"

The system was developed using a Component Off-The-Shelf (COTS) approach, then customizing the Cerner Millennium electronic health record software to meet the hospital's needs. As one system developer confirms:

"We customized the system to meet the user's needs, versus forcing the user to use the system"

Other users mention:

"ICIS is customizable", "We tried to design the system depending on how the doctors use it", and *"We tried to develop the system as much as we can to meet their requirements so we get the most of it"*

3.7. ICIS Implementation and Development

ICIS is a comprehensive system, which includes five modules including, Powerchart, FirstNet, PharmNet, SurgNet, and Pathnet. These five modules are interconnected together to provide the desired collaboration for all the different healthcare professionals in the hospital. Figure 3.6 below provides a general level of an illustration about the ICIS system.

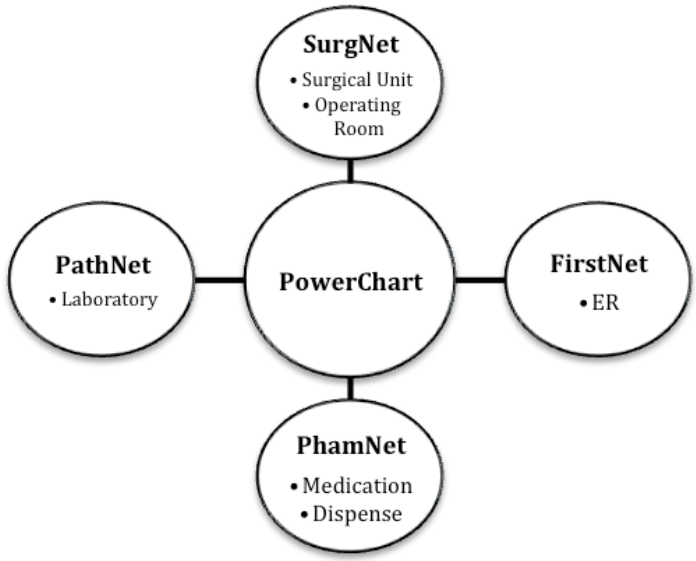

Figure 3.6 ICIS Integrated Modules

The implementation and development of the Integrated Clinical Information System was done through three different phases. Gradually, the hospital integrated the different practices into ICIS. Figure 3.7 below categorizes the different features involved in each phase. The hospital took about eight years to incorporate all the different groups of healthcare professions in the system, as one IT developers explains:

> *"We implemented the system through phases in order to enhance the physician's usability"*

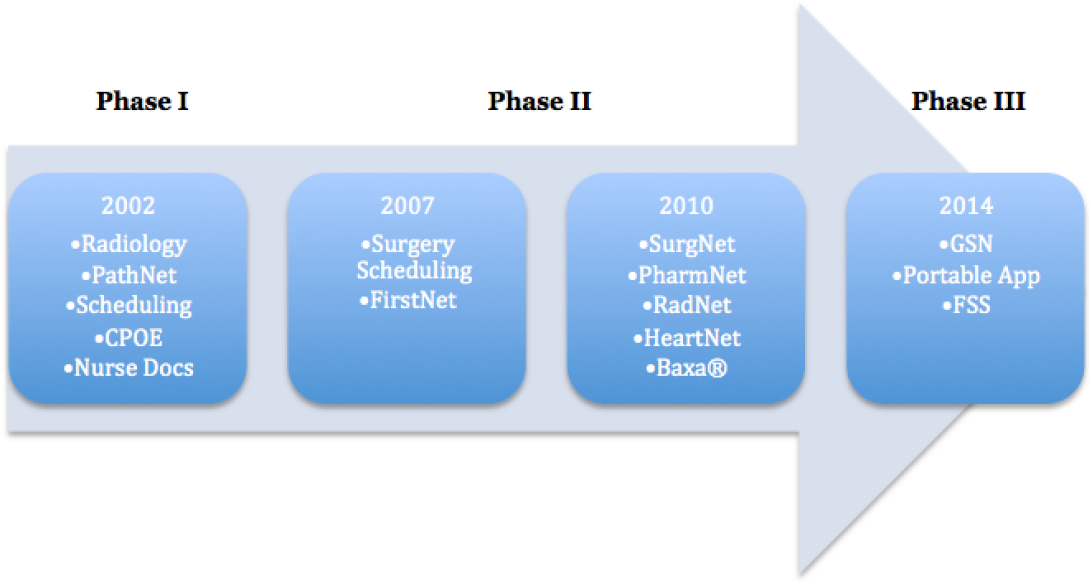

Figure 3.7 ICIS Implementation and Development Phases

The development of these phases resulted in interconnecting and integrating the five essential modules of the system. The first module that was part of initiating the ICIS project is PathNet, as one of the system developers' states:

> *"The project started with the laboratory department and the nursing unit as I recall, that was even before was initially launched. They -"the laboratory and the Nurse unit"- were heavily involved and active in making this project succeed, after couple of years SurgNet and FirstNet were integrated"*

PathNet is the module related to all the laboratory related records. It facilitates a medium for doctors, clinicians and nurses to incorporate evidence-based practices into patient treatment. For example, a lab technician remarks:

> *"Using this system, I can check the requests placed by the doctors, and know what procedure to perform"*

Other users describe this module:

> *"I know which doctor requested what test", "from the system I can tell when the test was requested, and when is it needed by"*

PowerChart is the main interface for all the users (doctors, nurses, and pharmacists) access when logging on the system. This module includes many features that enhance the user's usability for easier accessibility. As a doctor describes the module stating:

> *"The first page I open is the PowerChart, I have to search for my patient at first using the PRN, after I select my patient, I can check the medical history, appointment status and any future appointments, current notes and past notes, then I can place the course of treatment for this patient, or schedule the patient for additional testing"*

Users can modify certain features in Powerchart module for easier interface navigation and better performance. For example, users can create a favorites list for faster accessibility to their frequent processes. Figure 3.8 below provides a screen-shot of the PowerChart interface used in the hospital.

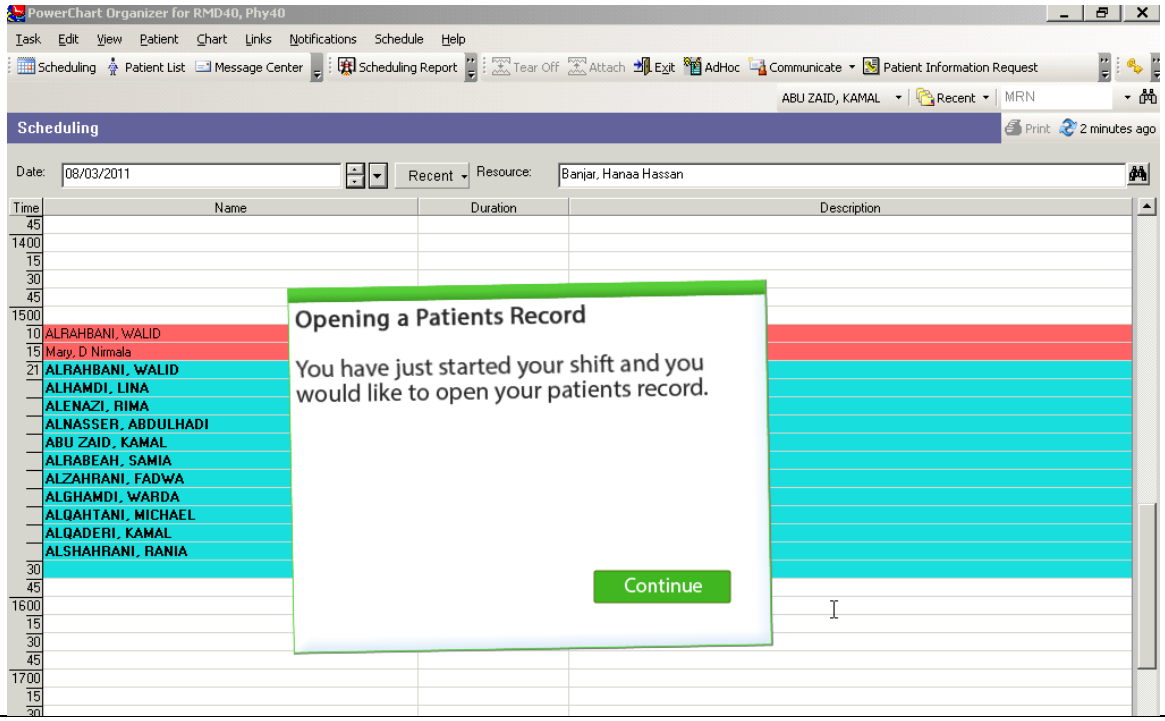

Figure 3.8 PowerChart Interface

FirstNet is another module used for the Emergency Department of the hospital (ER). This module is mainly used in this department's operations. Emergency physicians in the ER department are provided with powerful tools to help them operate during crucial times. This module also provides its users with improved and enhanced tools. These tools are mainly used to help emergency physicians treat critically ill patients.

PharmNet is the pharmacy solution module in the system. It enhances prescription legibility, order completeness, and provides a communication channel between the pharmacist and the different providers. Pharmacists and doctors primarily use this module. . For example, pharmacists use PharmNet as they dispense requested medication, as one-pharmacist states:

> *"I constantly receive medication request from the system, from here I see who is this medication for and by whom it was requested"*

Another pharmacist described this module as:

> *"The system will inform me on the medicine I should prepare and the person collecting the medication"*

Doctors constantly use PharmNet, as they are the only users who are eligible to place a prescription through the system. Through these and other means, KFSH&RC decreased the number of callbacks to physicians about clarifications of medication orders by 58 percent. Figure 3.7 below provides an interface screen shots of the medication request process.

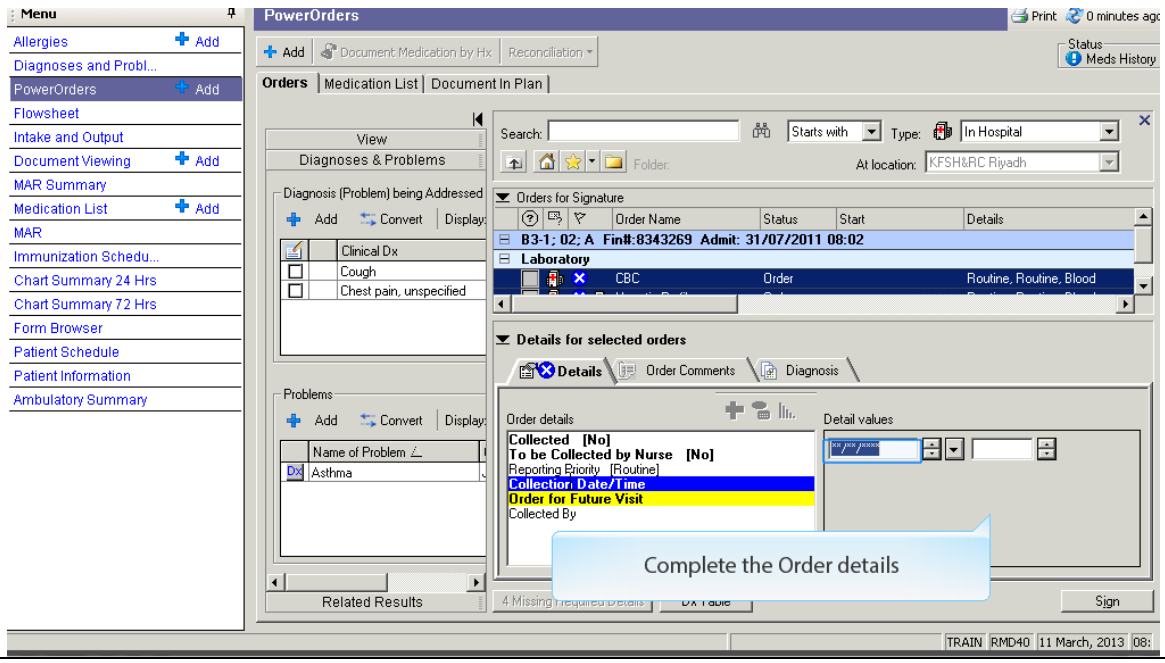

Figure 3.9 PowerChart Interface

Lastly, SurgNet is the module in the system related to the surgical unit of the hospital. The physicians in the Operating Room (OR) mainly use this module during surgical operations. This module provides surgeons with the appropriate tools to help them better operate. For example, one surgeon describes the SurgNet module:

"I can know which room I will be operating in and at what time all through this page"

The system was designed with the highest security standards to ensure accountability and maintain patient privacy. Users are granted accessibility depending on their role and their profession. Figure 3.8 below provides an example the high security level the system provides by requiring physician signatures for confirmation:

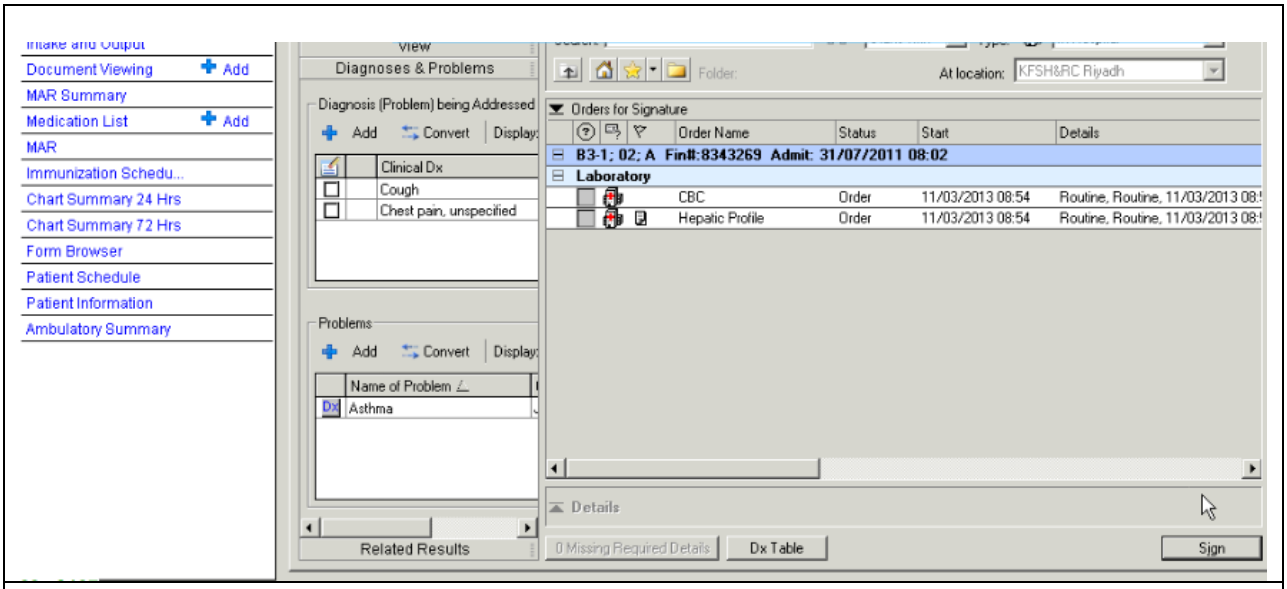

Figure 3.10 ICIS signature Request

Moreover, ICIS is designed to audit and monitor the system use, as it monitors such data. The majority of the users confirm the system's security features, as one doctor from the hospital highlights:

"This system is more confidential"

Several pharmacists also state:

"Every note that goes in the system, or even order that goes out is traced and monitored", " from who is putting the medication in, and what date is what logged, the system records it all"

During the development of the system and its use, the organization's IT department remained pivotal, being particularly instrumental in following:

1. Transforming the COTS based system into one more aligned with the organizational work groups through user driven customization.
2. Providing operational translating supports to make the user best realize the affordances within the system.

This has resulted in a well-liked and universally used system. As one doctor highlights:

"From all the hospitals I have worked in, KFSH has the best system in place"

Other respondents comment:

"The system made it easier to communicate", "the system saved us a lot of time and travel across the building of the hospital"

Consequentially, the system is an example of a successful IS implementation as users seemed to have an overall positive perception about it. As one-doctor mentions:

"I like ICIS much better than the past system I use to work on in King Fahad Medical City"

Other doctors and nurses describe the system as:

"Very easy system indeed", "very friendly and comfortable to use", "It makes my job much easier", " very straight forward. I like using it"

The exploration of the different work processes in KFSH&RC first indicated the existence of a number of distinct healthcare groups with different responsibilities and roles. Second, an extensive collaboration between such groups was also revealed from further exploration. Then it was apparent that ICIS (the focal IS) played a large part in facilitating

the daily workflow. An objective of the analysis was to try to understand the nature of such collaborative medium. In the next section, detailed arguments regarding these indications are elaborated upon.

3.8. Boundary Spanning Healthcare Organizations

First, the preliminary exploration revealed the existence of a number of distinct healthcare groups (e.g. doctors, nurses, pharmaceuticals, hospital IT*)*. Consistent with the concept of boundary spanning (Levina & Vaast, 2013), the analysis exposed how each group is structured with different well-defined boundaries. Each of these groups is also structured with a distinct separation of roles based on the healthcare profession's identity. For example, nurses are required to perform certain tests and procedures on new patients, and report their results to the assigned doctor. The majority of the hospital's nurses distinguish themselves from other healthcare practitioners as one nurse mentions:

> *"The nurses have assessments duties, vital science, and different requirements than the doctors".*

At the same time, there remains a critical and imperative need for collaboration. As a respondent states:

> *"Nurses and doctors work different ways but still they are working together and the doctor would check with nurse constantly and vice-versa"*

Second, to investigate the nature of the work within the organization, the researcher turned to the literature to draw on similar concepts, which examined work-processes in boundary spanning organizations. Literature on boundary spanning suggests that recurrent interactions structure the use of technologies in an organization. These structures enact the rules and resources, which shape the use of the technology (Levina & Vaast, 2013).

Therefore, during this analysis phase, the nature of interaction between the boundary spanning agents during the performance of their tasks was examined. Consequentially, the study examined each of the healthcare groups actions and activities, to understand the boundaries associated in each profession. For example, if one considers the nursing group, it represents a significant amount of the workforce, there being 1,942 nurses working within the hospital (KFSH&RC, 2013). Each nurse is responsible for three to four patients, and needs to attain all of the patient's calls, as well as changing the patient's bed linens. All the nurses are also required to log all the patient's information in the healthcare IS (ICIS). Similarly, the doctors and pharmacists also have their own workflows and processes. As one user mentions:

> *"Doctors have their own workflow differently than the pharmacy, and pharmacy is also different from administration or management office"*

Third, the researcher found that the overall organizational workflows emerged due to collaborative intersections within the different healthcare professionals. Additionally, the current healthcare IS (ICIS) of the hospital enabled a collaborative medium among different users by inscribing in itself the affordances for such collaboration. For example, one respondent stated while describing the prescription filling process:

> *"When I place a medication order, the pharmacist will know that I am the one who made the order"*

This interface used for prescribing the medicine was designed such that it fulfilled the information requirements of the pharmacy, while ensuring that the doctor remained identified, thus adhering to the norms of the doctors' profession. This evidence also suggests that the IT department in KFSH&RC played a pivotal role in both the implementation and continued use

of the healthcare IS (ICIS) used in the hospital. Figure 3.9 below explains the organizational context in KFSH&RC, and the boundary spanning role of the IT department.

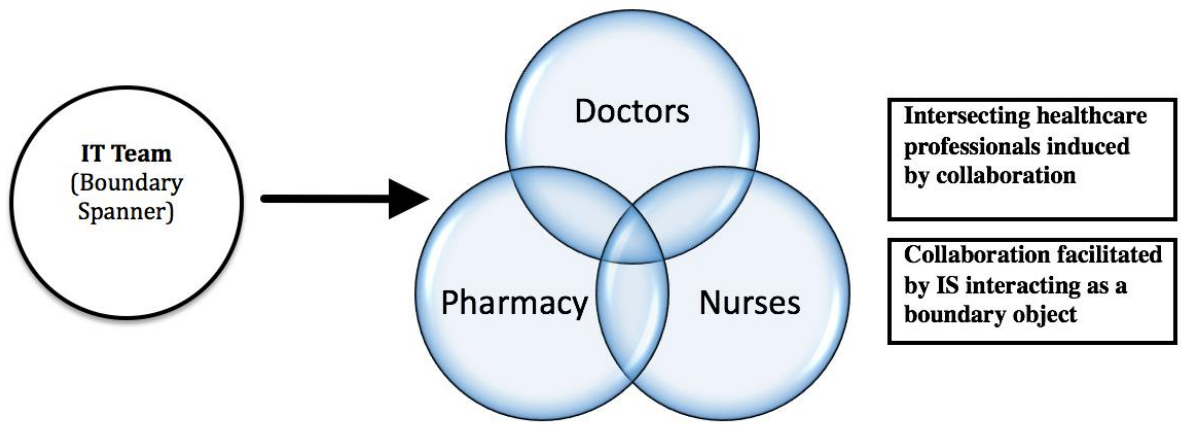

Figure 3.11 Role of IT the Organization

3.9. Summary

In conclusion, each healthcare professional group has its own hierarchy, chain of command and norms for work. A significant aspect of the work processes within the hospital was the collaborative interaction between these different groups. Such interaction required significant boundary spanning activities. Research suggests that IS often enables such boundary spanning by providing boundary spanning objects in the form of technological artifacts and boundary spanning functionalities (Levina & Vaast, 2005). Empirical findings from the collected data nominate the existing healthcare IS in KFSH&RC as such boundary object.

The interpretations of the collected data produced a series of leading themes. The first set of themes concerns the details of the boundary object facilitating the collaborative medium among the intersecting healthcare professionals. This focus further investigates the functional affordances that inscribe the collaborative norms of the distinct healthcare groups

within boundary spanning organizations such as a healthcare organization. In order to address this key objective, the first research question, *"What is the influence of the functional affordances of a healthcare information system in developing a collaborative space within a healthcare organization?"* was used to obtain interview responses from the study participants.

The second set of themes involved further investigating the role of the IT team in a healthcare organization. In particular, this focus directed the second research question towards the boundary spanning role played by the IT group in enabling the use of the healthcare IS, which facilitates collaboration among the distinct healthcare professions. The study addressed the second research question *"what is the nature of the boundary-spanning role played by the IT team in implementing and developing an integrated IS of a healthcare organization?"* to obtain data results from the interview participants. The next chapter reports the theoretical understanding that was gained through the analysis of the collected data regarding these two emergent themes, by providing a detailed narrative of the analyzed findings starting with a theoretical account.

4. RESULTS

This chapter elaborates on the theoretical narrative that emerged from the analysis of the empirical data obtained from KFSH&RC. The results of these theoretical narratives emerged two key findings that were guided by the two research questions stated in chapter one. The first finding focused on examining the healthcare IS user-interface design. The second finding focused on investigating the boundary-spanning role of the IT group in implementing and developing a collaborative and an integrated healthcare IS. This chapter elaborates on each of these findings by providing evidence-based arguments and discussions, starting with the examination of the healthcare IS user-interface design.

4.1. The Healthcare IS Design

The primary objective of this focus was to understand the workflow related to patient care within the hospital, explore the collaborations between members of the different medical professions, identify the relationship between their task of related goals and the technological attributes of the IS. This section reports the results of examining a successful healthcare IS. In particular, the researcher focused on the functional affordances of the healthcare IS to address the first research question:

1. What is the influence of the functional affordances of a healthcare information system in developing a collaborative space within a healthcare organization?

There are two key aspects of this theoretical narrative (see Figure 4.1). The first aspect involves the organization context and traces the nature of collaborative interactions within the distinct healthcare professionals in a healthcare organization, and its implication to patient care workflow design. The second aspect examines the Healthcare IS use context

within such a workflow. This suggests that such healthcare use depends on the relationship between the organizational actor's (e.g. the doctor, nurse and pharmacists) and the technology attributes (e.g. functional capabilities of the IS), and is particularly contingent on the perception of certain key functional affordances. The data further indicates that the perception of this affordances and appropriation of the same allowed for a successful use of the IS. The following section elaborates on each aspect of the theoretical narrative.

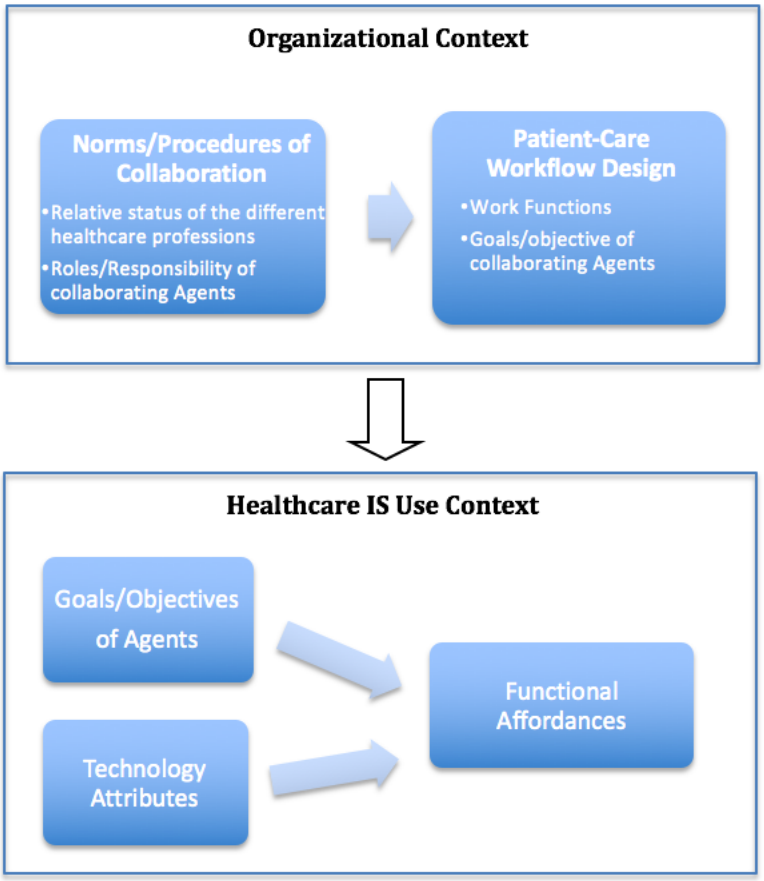

Figure 4.1 Theoretical Model

4.1.1. Organizational Context

The analyzed data indicates that patient care in the hospital is conducted through a collaborative workflow involving different medical professions (see figure 4.2). Most of the users confirm their constant collaboration between the different healthcare groups, as one respondent mentions:

> *"Nurses and doctors work different ways but still they are working together and the doctor would check with nurse constantly and vice-versa".*

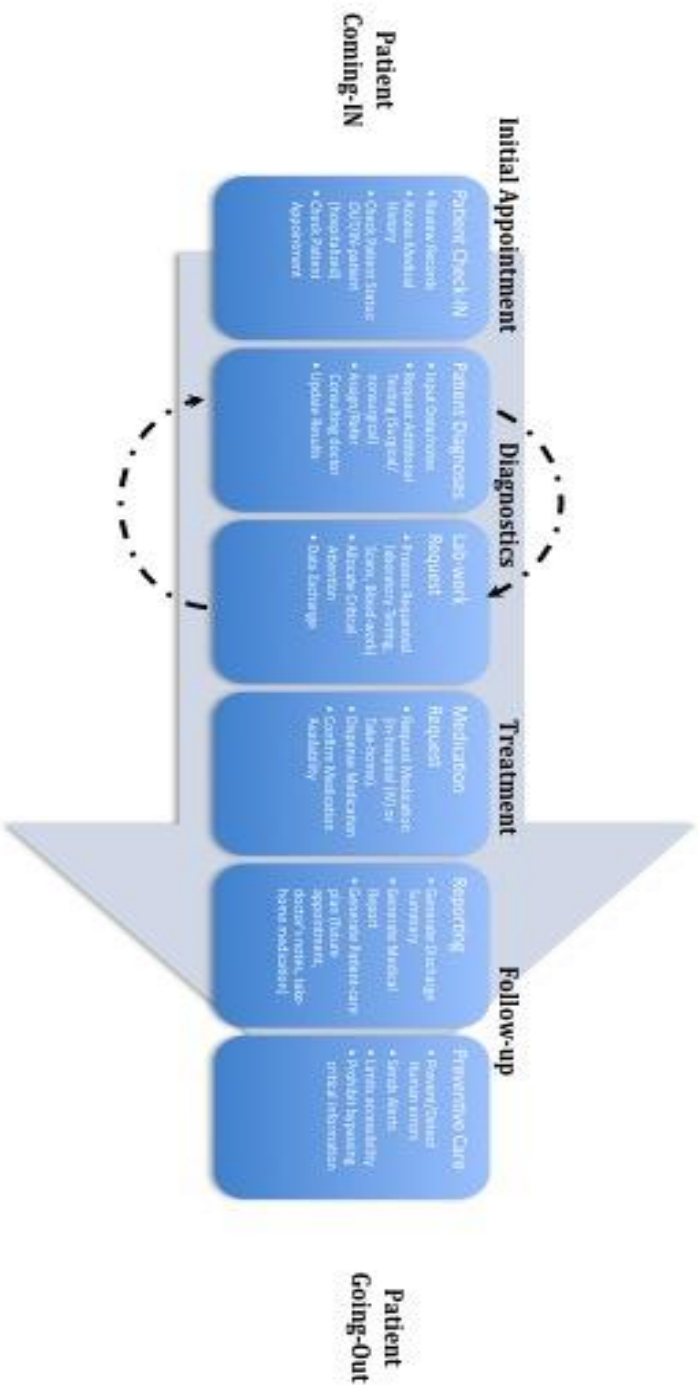

Figure 4.2 Patient Care Workflow

This collaborative workflow is distinguished by a few intriguing factors. First, the collaboration is very functionally demarcated with the doctors, nurses and pharmacists having well defined roles and tasks at every phase of patient care. Second, there is a relative hierarchy amongst these medical professions, where the doctors reside at the top of such hierarchy. However, despite this status difference, each profession retains authority over their functional domains (e.g. only the pharmacist who can dispense medicine, but not without the authorized prescriptions from a doctor). The collaborative workflow therefore emerges through interplay between this need to preserve this hierarchical relationship, while retaining a clear demarcation of the functional domain (see Figure 4.3 below). A consequence of this is that each of the collaborating actors (e.g. doctors, nurses and pharmacists), has differing goals and objectives for each of the phases within the workflow, and this influences their use of the healthcare IS, as well as expectations about it. The next section further elaborates more on this.

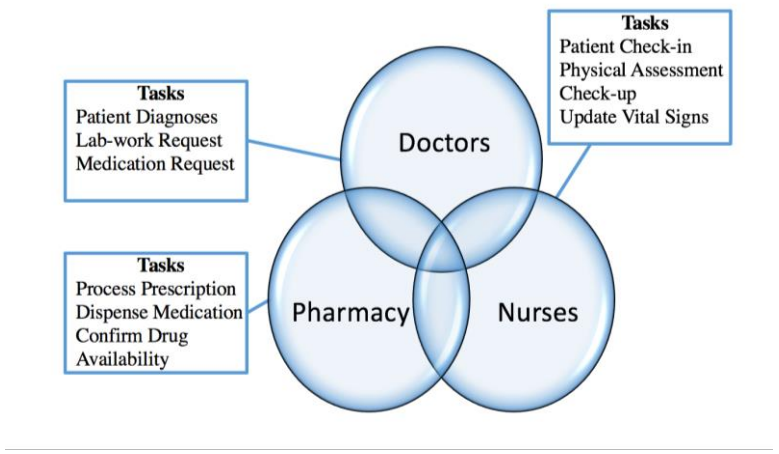

Figure 4.3 Collaboration

4.1.2. Healthcare IS Use Context

The analysis of the empirical data indicates that the IS use context at KFSH&RC is contingent on two primary elements:

a) The organizational context of collaborative norms and the functionally demarcated workflow design that is a consequence of such norms
b) The relational alignment between the goals/and objectives of the collaborating agents of the different healthcare professions, with the functional capabilities provided by IS (see Table 5 in the next page).

In other words, the IS embeds the procedural constraints of the organizational workflow and facilitates the enactment of collaborative norms by providing functional affordances (such functional affordances emerge from the alignment of objectives/goals with the functional capabilities of the IS (Markus and Silver 2008)).

Table 5 below provides a granular view of the nature of such alignment and the specific affordances that emerge as a result. For example, during the patient check-in function, the healthcare IS (ICIS) allows the doctors and nurses to achieve their goals by providing specific capabilities. Such as, access to common data and providing searching capabilities. For example, one respondent mentions:

> *"Everything about the patient's health is found in the system. Such as current and past symptoms, course of treatment, patient's test results, clinical results, x-rays, or any lab work done"*

	Actors	Goals/Objectives	System Features /Capabilities	Functional Affordances
Patient Check-IN	Doctor, Nurse	Doctor: • Review records • Access medical history • Check Patient Status • Inquire treatment Nurse: • Physical Assessment • Update Vital Signs • Schedule appointment	• Patient Look-up • Patient history records • Shared Interface and data • Search tool • Patient Status • Constraining of access	• Collaborative • Information sharing • Patient Tracking
Patient's Diagnosis	Doctors	• Input new data/notes • Update Patient records • Acquire/Request Additional Testing • Assign Patient's Consulting Doctor	• Shared Interface and data • Diagnoses recording tool • History update tool • Constraining of Access • Availability clinical reference • Recommendation of alternative medication	• Collaborative • Decision Making • Information sharing • Communication Facilitation
Lab-work Request	Doctor and Pathologist	• Exchange/share data • Transfer Data • Allocate Critical Attention	• Lab-work request • Task progress update tool • Shared interface and data • Lab-work report generation • Signature Authentication • Constraining of Access	• Collaborative • Information Sharing • Patient Tracking • Communication Facilitation
Medication Request	Doctor and Pharmacy	Doctor: • Request Medication Pharmacy: • Process prescription • Dispense medication • Confirm drug availability	• Prescription request • Update tool • Shared interface and Data • Drug profiling/labelling • Constraining of access • Signature Authentication • System alerts	• Collaborative • Decision Making • Information Sharing • Communication Facilitation
Reporting	Doctor and Nurse	• Generate reports • Choose and chart criteria	• Access to patient records • Charting tools • Search tool	• Collaborative • Information Sharing • Patient Tracking

Table 5 System Functionalities and Features

In addition, the healthcare IS (ICIS) also embeds the collaborative norms by constraining access to system features based on roles of the various healthcare professions. For example, the nurses can view patient history but not the confidential notes of the doctors, unless the assigned doctor explicitly granted access to the nurse. In other words, by providing capabilities such as shared data and viewing patient history, then aligning these capabilities with the objectives of the doctors and nurses, the healthcare IS provides collaborative and patient tracking affordances. As one doctor mentions:

> *"Nurses must log all the assessments performed on the patient in the system because the first thing we do when we see a patient is checking those records"*

similarly, the healthcare IS (ICIS) enabled collaboration in the patient diagnoses function. As one doctor highlight:

> *"we must log everything in the system"*

another doctor adds,

> *"while diagnosing, we must add notes then place medication, or ask for lab-work"*

The capability of providing such extensive notes engenders decision-making affordances, particularly for follow up visits or consultations with other specialists. Moreover, enabling the reporting functionality, allows all involved agents to exchange patient's information, chart a specific report, and track a patient's progress, thus facilitating communication and information exchange. As a hospital's nurse highlights:

> *"I can generate requested reports for a doctor in a matter of seconds "*

Another critical aspect mentioned in table 5 involves the pharmacy. By having a medication-request and preventive care functionality, the doctors and pharmacists were able

to collaborate and access common data and processes. For example, one doctor describes the prescription filling process stating:

> *"When I request patient's medication, the pharmacist can see that I am the one requesting it and for whom"*

other doctors also add:

> *"the system will inform me about the medication and dosage amount", "the system tracks who places the prescription and for who"*

The healthcare IS (ICIS) also prevents human errors from happening by, setting alerts and reminders if one user missed to provide critical related information. In the words of a doctor:

> *"The system works in such a way and such a manner that prevents human error to occur"*

Other users describe this system feature:

> *"if I forgot to put the dosage amount of the given drug, alerts pop up asking me to provide the amount","when I prescribe drugs that contradicts each other, the system wont allow me and pops a messege recommending an alternative drug ", "if I miss something, the system sends an alert stating the issue"*

4.1.3. Functional Affordances and their implications for healthcare IS design

A key aspect of the above narrative is that the functional affordances that emerge from the analysis procedures play a critical role in a successful and a meaningful use of the IS. Table 6 below further elaborates on these different functional affordances.

Functional Affordance	Detailed description	Quotes
Collaborative	This affordance allows the different medical groups (doctors, nurses, pharmacy, IT) to collaborate together to start a certain task, such as patient check-up and medication request. This affordance emerges because of the inscribing of the collaborative norms embedded within the workflow of the organization in the IS through features such as • Shared interface and data • Constraining of Access • Shared functional tools (e.g. patient tracking tool, status update tools etc.)	*"Basically, every test, scan, and procedures done here can be found in this one place. In a click of button! Which is easier than looking through papers. And much better than going to the labs and wait for results!"* *"This system is very helpful, I can check the nurse's input through the system before I go in and diagnose a patient"* *"After the nurse's enters the patient's information, I can read and review to better evaluate and diagnose the patient"*
Information Sharing	This affordance allows for simultaneous and live access to agents from different healthcare groups for fulfilling their task related objectives. This affordance emerges because of the IS features such as • Shared interfaces/tools • Integration of all patient-related date in one place • Synchronous access to patient documents	*"Uploading and downloading of scans and different kinds of images from different users persistently on the same system"* *"If all of this was in paper, we wont be able to work on a patient at the same time, as documents have to travel from one department to another"* *"Having a system allows us to review patients at the same time".*
Decision Making	This affordance allows the agents of the different healthcare groups take important decisions related to patient care, and explicitly follow the tenets evidence based medical practice This affordance emerges because of IS features such as • Availability of clinical reference information • Alternative medication recommendation • Availability of key diagnostic data	*"When prescribing medicine to patient, if there is a drug contradiction it will prevent us from making the request"*
Patient tracking	This affordance allows the different healthcare groups to monitor patient progress through different phases of the workflow	*" I can see everything related to patient in his file through ICIS"* *"Since the day he [the patient] was first*

	This affordance emerges because of IS features such as • Patient status tool • Patient history • Synchronous access to data	*treated, every appointment scheduled, every drug prescribed, and every procedure performed are recorded in the system"*
Communication facilitation	This affordance allows for communication across and within the different medical groups. This affordance emerges because of IS features such as • Tools to exchange information (e.g. chat tools, lab/medication request tools) • Notification/system alert tools	*"The system made our work here much more efficient, now I can upload the patient's test results, and within seconds, the doctor can see information from his own department"* *"I can request scans on the spot through the system, without physically having to go to the next building"* *"I schedule the patient's next appointment on the system, and the administration staff as well as the nurses will be notified"*

Table 6 Functional Affordances

There are a few things that are important to note about the functional affordances described above. First, these functional affordances are intricately linked to the collaborative context of an organization, because their emergence is contingent on the behavioural goals of the organizational actors. This allows for the possibility of using them as theoretical concepts that would facilitate the developing stronger linkages between the collaborative context of a healthcare organization and capabilities/features provided by an IS. Second, the affordances are also related to an assemblage of IS features/capabilities (a subset of the entire system capabilities). This allows for the possibility of deriving design prescriptions for an IS. In other words, an IS development initiative (in a healthcare context) could begin identifying critical affordances through an understanding of the collaborative goals of the stakeholders. They could then develop a set of design prescriptions (e.g. features) that satisfy these affordances. Third, given that the set of affordances have emerged from the examination of a successfully adopted IS, they provide starting point for the development of a more

sophisticated ontology that could be used to develop several usable designs patterns for a healthcare IS.

Another important focus that emerged from this dissertations' theoretical narratives regards the efforts of the IT group involved in the development stage (Schomburg et al., 2014) in embedding the identified functional affordances in the healthcare IS. Aligned with boundary spanning studies, a successful development of a healthcare IS largely depends on the IT developing team of gaining adoption in the industry (Levina & Vaast, 2013). The collected data highlighted how developing a successful healthcare IS, such as the healthcare IS developed in KFSH&RC (ICIS), requires the significant engagement of the IT group in understanding the nature of the different healthcare group's workflow. Published studies argued how IS developers often the early users serve as a sample to validate or invalidate appropriateness of the system features. Such IT groups act as 'champions' who encourage other system users to adopt them (X. Li et al., 2013; Liu et al., 2012; Schomburg et al., 2014). The next section uncovers the details of the role played by the IT group in KFSH&RC.

4.2. Boundary Spanning Roles of IT

This section elaborates on the theoretical narratives that emerged from addressing the second research question, "What is the nature of the boundary-spanning role played by the IT department in implementing and developing an integrated IS in a healthcare organization?" to obtain interview responses from the study participants.

Research on the role of boundary spanners suggest that boundary spanning agents need to be involved in translating, (re)-producing and negotiating the use of boundary spanning objects across the organization. Such agents are involved in translating the functionalities of the system, and enabling their use, through recursive interactions of

boundary spanning agents across the different healthcare professionals (Levina & Vaast, 2005, 2008, 2013). Further research suggests several conditions and requirements to qualify as a boundary spanner. For example, a boundary spanner must understand all the different healthcare professions in the healthcare organization, to be able to negotiate or renegotiate the relations and knowledge across boundaries, as well as negotiating the meaning and the use of the boundary objects by the different users. Moreover, boundary spanning agents are responsible for addressing the concerns of these diverse users (Levina & Vaast, 2005, 2013).

The collected empirical data illustrated the critical role of the IT group as such boundary spanning agent in translating boundary objects across boundary spanning activities. This finding is aligned with earlier research that have defined a boundary spanner as an individual who reach beyond boundaries to build common ground across diverse practices (Levina & Vaast, 2013). In particular, the IT group at KFSH&RC developed work processes (both during development and maintenance of ICIS) to actively solicit information from the diverse healthcare professionals and map the work-processes of these groups into an integrated system. In the context of an IT personnel:

> *"We tried our best to understand how the doctors and nurses work and what they need from the system to do, in order to make this system a successful one".*

Another user state:

> *"We constantly talk to doctors and learn about their daily job to build the features that would make their life easier".*

Such continuous translating activities resulted in the development of feature sets for the technology objects that were more usable and explicitly user driven. For example, a respondent remarked:

> *"From our deep involvements with the doctors we created a favorites tab in the system now, this tab allows the doctor to assign his/her favorite tools and the most recently used ones"*

The IT group was also found involved in facilitating the collaboration between the different healthcare groups. The collected data confirmed the engagement of the IT group in creating committees from different healthcare professionals to understand each other's roles. For example, the IT group was heavily involved in interacting with all the different practices in the hospital in order to maintain a functional efficient system. In fact, it continues to hold required monthly committee meetings to identify any new structures, workflows, and any user reviews about the healthcare IS (ICIS) performance. As a respondent remarked:

> *"We call them physician champion committees".*

Other users highlight:

> *"Every department has a committee, we have two committees in our department", "the nurse informatics unit have their own committee as well", "In this department, one committee is related to medication aspect, and the other covers the documentation".*

In addition, the IT group was also involved in transferring information across the diverse healthcare professionals and trying to understand and learn more about each group of these professionals in the hospital. A key aim of the IT group remains the building of common grounds between the diverse healthcare professionals to facilitate the collaboration

through the healthcare IS (ICIS), as well as addressing the concerns of the diverse groups. As a system developer comments:

> *"Certain Surgeons, Pediatricians, and also nurses meet with the IT department to report any updates or problems about the system".*

Other users of the system state:

> *"If someone had a problem with the system, they would call up #6666", "the helpdesk is available 24/7", "anytime we can call them to fix our problem with the system".*

While Help desks are not an uncommon feature, many conversations with the respondents indicated that this service was responsive and useful. There was also a further indication that the IT group was heavily involved in interacting with all the different groups found in the hospital. The IT group in KFSH&RC maintained a functional efficient system, by addressing the concerns of the different users and applying appropriate changes to enhance the employee's usability. Agents from the IT group were found involved in defining the different healthcare professions norms, structures, and boundaries. The IT group also assigned different agents from each department in the hospital to report the workflows and any system related issues that occur. The majority of the system developers confirm the involvement of the IT group, as one personnel mentions:

> *"The system changes depending on the people's use, for that we assign different people to report the activities involved in executing their daily workflow"*

Another IT personnel describes the committees as:

> *"Meeting with committee members from every side and part of the hospital, From the Surgeons, Pediatricians, and also nurses. We call the champion committee"*

Data findings also confirmed the engagement of the IT group in the continued use of healthcare system. One of the means is through extensive and well-designed system-training workshops. The IT group requires a system workshop from all hospital employees, and made it contingent for system access. The majority of the system users confirmed the involvement of the IT group, as one-user mentions:

> *"All of the users are required to go through the IT workshop in order to work in the hospital, otherwise, they wont get accessibility to ICIS"*

Other users comment about their training:

> *"I took a class and after this class they provided me with my login", "No workshop, No access", "New doctors MUST attend workshops"*

As can be gleaned from the above discussion, the IT group in KFSH&RC, developed workflows and norms both during the development and use of ICIS. Such workflows embedded within them a number of principles of boundary spanning activity. Given that the researcher was interested in understanding the nature of the boundary spanning in addition to evidence of its existing, the study examined the nature of the boundary spanning during the two distinct phases of the ICIS system timeline: development and maintenance (of the system in use). The collected data suggests that the nature of boundary spanning differed during these different sets of software engineering activity. The next section describes these phases in a more detailed manner.

4.2.1. Modes of Boundary Spanning

Research has labeled two modes of boundary spanning, Trans-active and Transformative. Each one differentiates depending on the agent's relations, the boundary object's use, as well as the active role of the boundary spanners (Levina & Vaast, 2013). Evidence in the collected data found both of these modes, but interestingly these were applied in different contexts. For example, the IT group was typically transformative during development activities, and trans-active for maintenance and system evolution related activities. Figure 4.4 illustrates the transition of the boundary spanning modes found in the collected data.

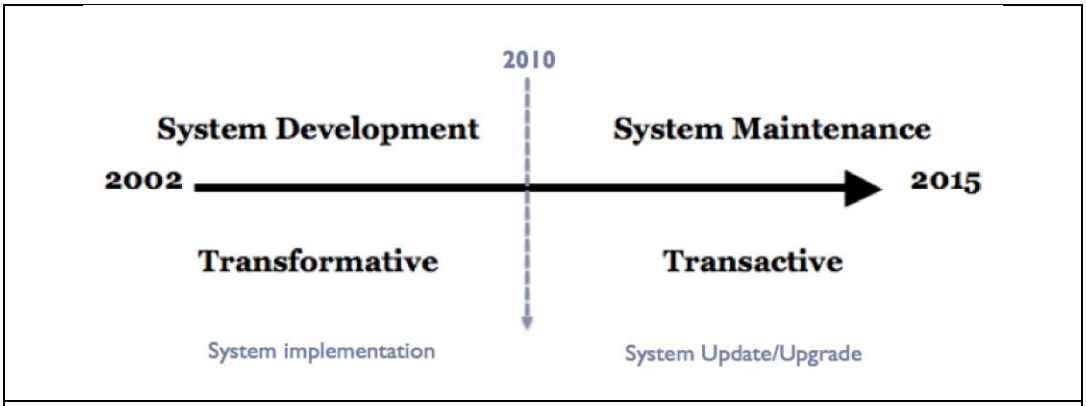

Figure 4.4 Changing Modes of Boundary Spanning

Similarly, table 7 below summarizes the differences of the boundary spanning activities. The table also elaborates on the different components related to system implementation and development activities. Such as, the evolution of the boundary object's use, the shifting role of the boundary spanners, and the relationships among agents.

Mode	Boundary Object	Boundary Spanner	Agents
Transformative	• Represent different healthcare groups • Create a shared space among users • Facilitate collaboration	• Translate definition of professions • Negotiate meanings of objects •	• Produce novel relations • Experience challenging work • Requires collaboration • System use: Immature
Trans-active	• Transfer information • Translate process requests	• Translate relations across boundaries • Reduced interactions with diverse healthcare groups	• Reproduce existing relations • Produce/contribute transactional work • System use: Mature

Table 7 Boundary Spanning Modes

In the transformative mode, boundary spanners invest effort to develop boundary objects that represent the diverse users, and develop a shared space (Levina & Vaast, 2013). The collected data reveals, the IT group at KFSH&RC made explicit attempts to design a system that not only represented diverse healthcare professions, but also represented a shared space for their collaborative workflow. For example, an IT developer remarked:

> *"In order to know what any of the doctors, nurses or lab assistants require from our system for example, we try to understand how they interact among each other as well as with the patients"*

Another respondent states:

> *" We started by learning their daily job and understanding what tools can help them best"*

The collected data also revealed the collaboration among the doctors and pharmacists. For example, a doctor describing his work process indicated how the system allowed a share space to exist between doctors and pharmacists:

> *"Now I can place a medication order and it will go to the pharmacy on the spot"*

Other doctors described this collaborative space stating:

> *"When I place a prescription, the pharmacist will see who placed the order and for who it is placed", "the system will alert me if there is any contradictions with other medications", "when placing a medicine prescription for one of my patients, I must enter all the information in, such as the dosage amount and the course of treatment. And while entering the drug information in the system, it will notify me for any alternative or a generic drug".*

Research suggests that transformative boundary spanners have to act as both translators and negotiators in order to build or transform a new joint workspace. Moreover, agents in this phase produce novel relations (Levina & Vaast, 2013). When examining the development activities, the collected empirical data yielded themes that were similar to Levina and Vaast's notion of transformative boundary spanning. It emerged that during such activities the IT group (boundary spanner) remained active translating and negotiating the terms and structures of the system as well as its use. As one IT developer mentions:

> *"We were heavily involved in trying to convince the physicians to the use the system properly at first"*

Other system developers' state:

> *"Users are the biggest challenge for the system", "Some doctors are old fashioned and like the paperwork form better", "it is very challenging to change people's behavior"*

While the IT group demonstrated predominantly transformative boundary spanning mode during development activities, as discussed above, they were more trans-active, during maintenance activities. In the trans-active mode, boundary spanning agents primarily act as translators (Carlile, 2004; Levina & Vaast, 2013). This mode is characterized by a reduced need for frequent interactions with the diverse users of the hospital, as the boundary object in use (ICIS) has reached a certain state of maturity. Consequently, the IT group has focused on optimal system usage by being an advocate of the system, pointing out new features or better ways to use them. This has been done through establishing a support system, and also by providing forums where users can provide their feedback. As one system user indicates:

> *"We have assigned designated doctors and nurses from every department to report any problems encountered with the system use".*

During the maintenance phase and current usage of the system, a difference was also observed about the perceptions of the boundary object. The IS is perceived as more mature, and is accepted as an integral part of collaborative users of the different healthcare groups. Additionally, the system has become widely accepted as the conduit for information and data transfer. For example, a respondent remarked:

> *"Now we can prescribe medication automatically through the system, this made it easier to both us as doctors as well as the patients"*

Other users describe the system as:

> *"The system made it easier to communicate with the laboratory department", "the system has the pharmacy built in it, which made ordering medication much easier!"*

4.3. Chapter Summary

The interpretation of interview and documentary data produced two series of dominant themes. First, the healthcare IS, formally known as Integrated Clinical Information System (ICIS) provides such boundary spanning capabilities by embedding in itself the features that provided the agents of different users, the affordance for collaboration. For example, one of the respondent states:

> *"The system now includes the laboratory, the pharmacy, and everything related to the hospital in one place, starting from one page!"*

Other users mention:

> *"The system is one of the easiest system I used in Saudi, and I was recruited through several hospitals before I come here", "Easy to learn, and very easy to use", "Simple for me, but it is an advanced comprehensive system!"*

The second primary conclusion that emerged from the theoretical narratives of the empirical data is that successful IS development begins with forming a strong engaging team from the organization's IT group to act as effective boundary spanners. Nevertheless, the transformative role of such boundary spanners, or boundary spanning agents needs to shift and change to a transactive role, as the development of the healthcare IS (boundary object) lunches. The following chapter elaborates on the different contributions gained from conducting this study for both the IS research and the healthcare practice.

5. CONTRIBUTIONS

This dissertation discussed the case study about the use of a healthcare Information System (IS) in Saudi Arabia. The theoretical perspectives adopted in this research increased the researcher knowledge about the effect of the design specifications of an IS on the meaningful use of a healthcare IS. The concept of functional affordances is not new to the IS research. Recent HCI studies highlight the numerous benefits of embedding such affordances within the design of an IS (Markus & Silver, 2008).

In addition to the concept of functional affordances, the collected data confirms the significant boundary spanning activities found in a healthcare organization. In particular, consistent with previous literature, the theoretical narratives emphasize the critical role of the IT group in developing a meaningful use of the healthcare IS. Moreover, drawing on the concept of boundary spanning, the study nominates the healthcare IS formally known as an Integrated Clinical Information System (ICIS) as a boundary object. The data emerged a successful development of the healthcare IS (ICIS) by the IT group, which facilitated collaboration and boundary spanning activities among distinct healthcare professionals (Levina & Vaast, 2005), by embedding in itself the norms and design characteristics that provided the agents of different practices, the affordance for collaboration.

This research has some interesting implications for both IS research and practice. The findings in the previous chapter, while preliminary, provide certain conceptual contributions toward examining an IS within a hospital context. A key premise of this research was that healthcare organizations represent a distinctive collaborative context, requiring the development of stronger linkages between this and the design specifications of an IS. Further, there are two primary conclusions that emerged from conducting this study.

The first key finding concerns identifying critical affordances through an understanding of the collaborative goals of the distinct users. Further such functional affordances provide a means for developing design prescriptions that are intrinsically linked to the collaborative goals of the organizational actors. The second key finding emerges from answering the second research question is that a successful healthcare IS implementation requires the organization's IT group to act as an effective boundary spanner. Such primary conclusion highlights the importance of investing in a strong and a qualified IT team in healthcare organizations. This chapter elaborates on the different theoretical and practical contributions gained from these two key findings, then concludes by providing considerations and recommendations for future research.

5.1. Theoretical Contribution

The empirical interpretations of the findings provide fruitful avenues for further investigation for the IS research and the discipline. In particular, the interpretation of the empirical data produced certain conceptual contributions toward examining an IS within a hospital context. This section elaborates on the different theoretical contributions gained from conducting this research.

First, based on the concept of boundary spanning, this research suggests a particular perspective, which explicitly acknowledges the existence of collaborative interactions within the distinct healthcare professional actors within a healthcare organization and its implication to patient care workflow design. The researcher argues that work processes within hospitals therefore necessarily compromises significant boundary spanning activities. Consequently, development and inscription of the collaborative norms and functional affordances for facilitating such collaboration becomes critical.

Consequentially, such healthcare IS use depends on the relationship between the organizational actor's (e.g. the doctor, nurse and pharmacists) and the technology attributes (e.g. functional capabilities of the IS), and is particularly contingent on the perception of certain key functional affordances. Therefore, the healthcare IS play a critical role by providing the artifact for inscription of such affordances and becomes a boundary object that facilitates boundary spanning amongst the different healthcare groups.

Second, the existing IS (ICIS) was found useful, and was used extensively because of its exposure of bundle of technology features that explicitly facilitates interaction between the agents of the different healthcare professions, through the provision of important related functional affordances. For example, doctors and nurses were found to extensively share boundary objects-in-use such as reporting tool, and common interfaces for updating patient records. Therefore, this study argues that functional affordances provide a means for developing design prescriptions that are intrinsically linked to the collaborative goals of the organizational actors. The analysis of the collected data regarding the patient workflow within a healthcare organization and the use of an IS within it, which indicates that such workflows emerge from the norms and regulations relating to roles, tasks, and collaborative interactions between the members of the key medical professions. Furthermore, such workflow is characterized by differing goals/objectives for the members of different work functions.

Third, the research suggests a mechanism for conceptualizing functional affordances and what they represent for the use and design of an IS within healthcare. The bundle of the different functional affordances identified within this research explicitly facilitates successful

collaboration amongst the different practices and therefore represent the inscribed objectives of the collaboration.

While the emerged contributions from answering the first research question were insightful, a different set of theoretical contributions emerged in this study by answering the second research question stated in chapter one, which concerns the second key finding of this research that explicitly highlights the boundary-spanning role of the IT group regarding a successful implementation and an efficient use of IS in a healthcare organization.

A primary conclusion that emerges from this empirical finding is that a successful IS implantation and use scenarios require the organization's IT groups to act as effective boundary spanners. The emergence of the effective boundary spanning role played by the IT groups have some key contributions to the IS discipline.

First, from a theoretical point of view, the empirical findings contribute to IS research by providing a novel lens in terms of boundary spanning, and further explicating the role of the IT department within a healthcare organization in terms of a theoretical framework. This lens provides a relevant and insightful theoretical framework for investigating other IS development and use related phenomenon. For example, the critical role of the IT department identified in this study provides a preliminary set of qualifications regarding the type of agents in boundary spanning organizations.

Second, the preliminary analysis of the collected data provides characteristics of such agents. Agents from the existing IT department in KFSH&RC were found very cooperative, and were heavily involved with all the users from the different healthcare professions of the organization. This lens contributes to the IS research as it provides a relevant and insightful theoretical framework for investigating other IS development and use related phenomenon.

Third, the study suggests that boundary spanning activities need not be uniform, and also suggests that transformative mode of boundary spanning is more suitable for development related activities, and transactive mode is more for maintenance related activities. Furthermore, the identification of the relationship between IS development processes and boundary spanning modes, contributes to the IS discipline by providing interesting insights about optimality of boundary spanning modes and changing roles of both the agents and the technology in use as the boundary object.

Forth, the analysis of the collected data provides indications of the users changing roles within KFSH&RC. In particular, actors from the IT department were found to be less involved with the different actors from distinct healthcare professions (doctors, nurses, pharmacy), as the system transitioned from its implementation phase into its development and maintenance phase. Likewise, actors from these different healthcare groups, were found to mature in their use of the boundary object (the healthcare IS used in KFSH&RC: ICIS), as the healthcare IS transitioned from implementation to its maintenance and development phase.

Lastly, this study provides another theoretical contribution that emerged from the identification of the relationship between the IS development processes and the different modes of boundary spanning. It contributes to the IS research by opening up the possibility of developing a more granular understanding of IS development and use in an environment of diverse professions.

In addition to these valuable theoretical contributions gained from conducting this research, the study emerged key practical implications for the design and use of a healthcare

IS. The following section further elaborates on these different practical contributions gained from conducting this case study.

5.2. Practical Contributions

This section illustrates some interesting insights, and different lessons, which can be useful for IS developers and designers in similar healthcare context as KFSH&RC. The conclusions of this case study emerge several implications for practice, because they provide some prescriptions of how to navigate the somewhat unique organizational context posed by healthcare organizations.

The empirical data indicates the organizational actors appropriate use on different sets of system features made available by the IS for achieving their goals. This pattern of appropriation and use of system features based on goals led to the emergence of salient functional affordances for every phase of the workflow. The emergence and identification of the affordances lead to some key implications for the design of healthcare IS.

First, the affordances present a novel analytical lens that could be used to develop requirements and design specifications for healthcare IS. Such a lens could be inherently useful as it allows the expression of possible linkages between the socio-behavioral context of a healthcare organizations and system features of an IS. For example, several design elements regarding interface design development emerged from conducting this study; these could be informative to practice, even in terms of template or guideline adoption. The preliminary analysis of the data illustrates how functional affordances are embedded in the characteristics of the IS interfaces, which offers good design features for related healthcare IS design. For example, the boundary spanning role of the healthcare IS, formally known as (ICIS) in KFSH&RC as a boundary object, in a successful integration of IS resources,

provides inspiration for related IS developers and system designers to include practical design ideas within the formal design of a healthcare IS.

Second, given that these affordances emerge from a successful healthcare IS (ICIS), there are some indications that they could be influential in successful adoption and use of a healthcare IS. Particularly, identifying the preliminary functional affordances and technology capabilities embedded in a successful healthcare IS (the boundary object). Such identification offers the seeds for a starting point of implementing and designing a fully functional IS in a healthcare organization. The affordance characteristics could also provide the necessary elements design for a healthcare IS interface implementation. In particular, this direction of research could provide valuable insights into the essential design characteristics (of IT artifacts) that enable collaborations between different healthcare professionals.

Third, the identifications of the agent's motives and goals increases the IS developers understanding of the different implications of agents actions. Likewise, the identification of linkages between system features and individual affordances also provides certain prescriptions of the desirable elements for successful use of a healthcare IS. For example, IS developers in KFSH&RC were found very committed to engage with the different users from distinct healthcare professions, to embed the critical norms and functional affordances within the functionalities of the healthcare IS. In the case of KFSH&RC, the engagement of the IS developers within the different medical groups of the hospital increased the chances of the IS success. These engagement efforts could also be extended to other similar developing contexts.

Forth, the boundary spanning role of the IT group in KFSH&RC, in a successful integration of IS resources, provides encouragement for practice to include theoretical ideas

of such activities within the formal design of organizational workflow. The empirical data illustrated the critical role of the IT department in facilitating collaboration amongst the different users. For example, the IT group was found as the leader in creating champion committees". The collected data confirmed how these committees involve the engagement of the distinct healthcare professionals, and its main purpose is to increase the hospital's knowledge regarding the role of each profession in the organization. Many users highlight:

"Every department has a committee, we have two committees in our department", "the nurse informatics unit have their own committee as well", "In this department, one committee is related to medication aspect of the practice, and the other covers the documentation".

Fifth, the theoretical narrative contains numerous good practices followed by the IT group at KFSH&RC; these could be informative of practice, even in term of piecemeal adoption of these practices. The preliminary analysis of the data provides indications of several good practices. For example, the IT group was found actively soliciting information from the diverse healthcare groups (doctors, nurses, pharmacists) to map the work-processes of these groups into an integrated healthcare system. In the context of an IT developer (an active agent from the IT department at KFSH&RC):

"We constantly talk to doctors and learn about their daily job to build the features that would make their life easier"

Lastly, the theoretical identification of a relationship between IS development phase related activities and boundary spanning modes also indicates further directions for an IS development guidelines. For example, the changing role of the boundary spanning agents

identified within this research explicitly facilitates a smoother introduction of healthcare IS to the distinct healthcare groups. As one respondent remarked:

"It wasn't as easy at the beginning, but the IT people were very helpful and we can call them anything we found an issue using the system"

5.3. Conclusion and Research Summary

The key to an efficient provision of healthcare is the design and implementation of healthcare Information Systems (IS) to increase information sharing and interconnectedness within and among organizations (E. Davidson & Chiasson, 2005; Haux, Ammenwerth, Herzog, & Knaup, 2002; L. Li et al., 2009; W. Li et al., 2014). Healthcare IS provides for efficient patient care, with faster admittance times, less paperwork, less staff needed for patient care, manageable and accessible data, and timely medication and/or treatments (Blaya et al., 2010). Healthcare IS also helps healthcare providers to operate nationwide and worldwide (Blaya et al., 2010; Charette, 2006). Related research show while healthcare IS are beneficial, there are problems associated with their implementation, design and use. Recently published studies suggests that for an IS to be functional, the diverse healthcare professions must be interconnected, and there must be a healthcare system integration, with appropriate training and support, and consideration for privacy and equality, and cost effectiveness (E. Davidson & Chiasson, 2005; Haux et al., 2002; W. Li et al., 2014).

This qualitative case study was conducted to gain a better understanding and develop an insight how diverse professionals of a healthcare organization collaborate, initially by answering the two research questions of this research. In order to answer such questions, literature suggested analyzing the healthcare professionals and the structure of such groups that defines their distinctive norms and boundaries. Consequentially, this study adopted an

interpretive approach to conduct this research (Walsham, 1995), while borrowing Grounded Theory Method (GTM) procedures as a guide for its data analysis (J. M. Corbin & Strauss, 1990). Nonetheless, applying the Grounded Theory Method (GTM) on the interpretive case study approach rewarded this research with greater and richer results.

The study also adopted an appropriate research design for further studies. The sample and design chosen enriched the findings of this case extensively. Conducting face-to-face interviews enlightened the study with an in depth understanding of the participants' experiences and an overall understanding of the phenomenon. In addition to the participants input, and the site for the data-collection allowed the researcher to collect valuable amount of rich and valuable data from multiple resources.

In conclusion, the theoretical narratives of this research provide fruitful avenues for further investigation for both this research and the discipline. First, there is an indication that within this healthcare organization, the development of functional affordances of the design of a healthcare IS happens through a recursive interaction between agents interactions across diverse users and the organizational structures that facilitate such boundary spanning. Such findings of this research are based on a stable configuration within the organization, but there are indications of an evolution that must occur within the organization. A necessary next step of this research is the exploration of this evolutionary process as this could provide key to understanding how design characteristics evolve for IS within a workflow.

Second, the identification of the preliminary affordances and technology capabilities provide the seeds for a more detailed ontology of the healthcare IS designs. Finally, this research also indicates that the intensive collaboration between the different users is also facilitated through extensive maintenance and evolution of the technology objects. These

require certain boundary spanning agents that can translate functional affordances critical for agent collaboration into explicit, meaningful boundary objects in use, and maintain them as well. For example, a respondent remarked:

> *"If a system acts up and I as a user do not know how to fix it I can call the help line and they can walk me through fixing my issue, or if it requires a technician's help an IT personnel from the hospital's IT department would come wherever I am to resolve the issue".*

It is hoped that this case study will help provide the necessary thread between all stakeholders about what is missing and what is needed to achieve sufficient collaboration for the betterment quality of patient healthcare. However, while this dissertation represents a preliminary step at examining healthcare IT operations from a boundary spanning perspective, the exploratory nature of this research brings with it the implication of an initial conceptual foundation that needs to be enriched by further research. In this regard the research team sought to meet this gap by assigning future investigation efforts, which dig deeper into the issue of healthcare IS use and design carried out in the Saudi Arabia context. The researcher believes that this direction of research could provide valuable insights into the essential design characteristics (of IT interfaces) that enable collaborations between the different healthcare groups. The following section further elaborates on the different future plans by identifying the limitations of this research.

5.4. Limitation and Future Plans

While this dissertation indicates some interesting implications of a successful use and design of a healthcare IS (ICIS), the findings of the research is quite preliminary, and further conceptual development is essential for a more concrete theoretical and practical

contributions. The research team believe that there are some obvious directions for future research.

First, the study sample was limited to the user groups within the subdivisions practices of a leading Saudi Arabian hospital. As a result, findings of this research may not be generalizable to a broader population. Any effort at generalizing this study must be done with caution. In this regard, further investigations involving more groups of participants drawn from a different set of healthcare environments would be more beneficial.

Second, the initial taxonomy of affordances identified in this research need to be further enriched through a) more explicit mapping of system features and goals to the affordances, and b) identification of possible interrelationships between the affordances. Such research could lead to the development of a more sophisticated ontology of functional affordances deemed critical for healthcare IS and to subsequent reusable design patterns.

Third, the examination of a successful IS leads to some (but not conclusive) evidence of a relationship between affordances and successful use of IS. The possibilities of such a relationship needs to be explored, perhaps through the exploration of the use of a less successful IS. A subsequent cross case analysis could lead to a further vindication about the nature and implication of such a relationship. Conducting an additional cross case analysis study could be used to indicate if the theoretical findings gained from this study could be replicated in a different setting (Yin, 2003).

Finally, this research analyses the case of a successful implementation and use of a healthcare IS. Further investigations of the evolutionary processes involved in implementing a healthcare IS would be beneficiary. As this research was first initiated by a study from a different hospital using a less developed system (King Khalid University Hospital), further

investigation efforts the evolutionary process of that system development processes is being considered for future research plans.

In conclusion, the results of the researcher's investigation efforts as well as the different limitations provided motivation for future research. In this regard, the research team sought to meet this gap by assigning future investigation efforts, which dig deeper into the issue of healthcare IS design and use carried out in the Saudi Arabia context. The researcher also believes that this direction of research could provide a valuable insight into the essential design characteristics (of IT interfaces) that enable collaborations between the diverse healthcare professions representing healthcare organizations.

6. APPENDICES

6.1. Appendix A: IRB Approval

TOWSON UNIVERSITY

EXEMPTION NUMBER: 14-X064

To: Deema Alsekait
From: Institutional Review Board for the Protection of Human Subjects Stacy Spaulding, Member
Date: Thursday, December 12, 2013
RE: Application for Approval of Research Involving the Use of Human Participants

Office of Sponsored Programs
& Research

Towson University
8000 York Road
Towson, MD 21252-0001

t. 410 704-2236
f. 410 704-4494

Thank you for submitting an application for approval of the research titled,

Examining standardizing issues in electronic health records in Saudi Arabia

to the Institutional Review Board for the Protection of Human Participants (IRB) at Towson University.

Your research is exempt from general Human Participants requirements according to 45 CFR 46.101(b)(2). No further review of this project is required from year to year provided it does not deviate from the submitted research design.

If you substantially change your research project or your survey instrument, please notify the Board immediately.

We wish you every success in your research project.

CC:
File

Figure 6.1 IRB Approval

6.2. Appendix B: King Faisal Hospital and Research Center Study Approval Form

مستشفى الملك فيصل التخصصي ومركز الأبحاث
King Faisal Specialist Hospital & Research Centre
Gen. Org. مؤسسة عامة

سعادة المشرف الدراسي حفظه الله

السلام عليكم ورحمة الله وبركاته

إيمانا بالتعاون بين مختلف المؤسسات الحكومية بما يرجع بالنفع على خدمة للوطن في شتى المجالات ، وبصفتي استشاري في قسم طب العائلة في مستشفى الملك فيصل التخصصي ومركز الابحاث بالإضافة إلى أنني أستاذ مشارك سابقا في كلية الطب بجامعة الملك سعود أوافق على إجراء بحث المبتعثة ديما محمد عبدالعزيز السكيت (مبتعثة لمرحلة الدكتوراه في نظم المعلومات في الولايات المتحدة في جامعة تاوسون في ميرلاند) من حيث تجميع البيانات وعمل المقابلات سائلين المولى عز وجل أن ينفع بعلمهم الوطن.

وتقبلوا سعادتكم خالص تحياتي

الدكتور عبدالعزيز ناصر الناصر

مستشفى الملك فيصل التخصصي ومركز الأبحاث

Form 11100-01 (Rev. 09-27) I.C. 202028 Printed by Reprographics (Print Shop) KFSH&RC

Figure 6-2 Hospital Approval Form

6.3. Appendix C: Consent Form

Dear Participant,

My name is Deema M. AlSekait and I am a doctoral student in the department of computer and information system at Towson University. As a part of my research dissertation, I will be conducting one-on-one interviews to identify and describe standardizing issues and barriers to Electronic Health Records in Saudi Arabia.

If you choose to participate in this interview, an informed consent will be obtained from you to insure that you are volunteering to participate in this study. You may choose not to answer a question or withdraw from the study at any time with no consequence. You may ask questions at any time to avoid any confusion, risk, or harm. Your choice whether or not to participate in this interview will not affect your employment status. Your supervisor has agreed to conduct this interview at your workplace. He/she will not be informed on your participation.

Last but not least, your employment will be maintained confidential, and private at all times. The interview data a will be anonymous. Data will be kept in a secure place available to the researcher only. Confidentiality regarding the participant will be maintained with the use of identification numbers in place of names. A copy of the questionnaire to be used in the study has been included with the IRB submission

If you have any questions about the study, you may contact me at (0541)-(466466) or email (dalsekait@gmail.com), Suranjan Chakraborty (410-704- 4769), (schakraborty@towson.edu) or the Chairperson of Towson University's Institutional Review Board for the Protection of Human Participants, Dr. Debi Gartland, at (410) 704-4110. A copy of the survey results, reported in aggregate form, will be available to you upon request

Thank you for your participation and collaboration in this study.

Participant _____

Figure 6.3 Consent Form

6.4. Appendix D: Electronic Mail (E-Mail) Script

E-Mail Script

Dear (Hospital Name) Employee,

My name is Deema M. AlSekait; I have been forwarded to you from your supervisor. I am a doctoral student in the department of computer and information system at Towson University in the United States of America. As a part of my research dissertation, I will be conducting one-on-one interviews to identify and describe standardizing issues and barriers to Electronic Health Records in Saudi Arabia.

Your supervisor has agreed to conduct this interview at your workplace. He/she will not be informed on your participation. Moreover, your participation in the interview will be maintained confidential, and private at all times. Your choice whether or not to participate in this interview will not affect your employment status. If you choose to participate, please let me know what is a suitable date and time to set up the interview.

I greatly appreciate your participation.

Thank you for your involvement and collaboration in this study.

Deema M. AlSekait
E-Mail: dalsekait@gmail.com
Phone: (202) 549-2288

Figure 6.4 Electronic Mail (E-Mail) Script

6.5. Appendix E: An Interpretive Investigation on the Healthcare IS in KFSH&RC

As is frequently the case in interpretive research, theoretical perspectives from existing IS research helped in framing as well as interpreting the data. First, this study on the examination on the use and design of a healthcare IS was informed by the concept of boundary spanning. Boundary Spanning with its capacity to explain the healthcare context and their collaborative inherited nature across an organization's boundaries, provided the study with the framework to gain further insights into the nature of the collaboration found in a healthcare setting (Carlile, 2004; Levina & Vaast, 2005; Orlikowski, 2002).

Adapting such perspective increased the researcher understanding about the recurrent actions performed by the different agents from four distinct healthcare professional groups (doctors, nurses, IT personnel, and pharmacists). Each group has its own agents, hierarchy, chain of command and structure. As agents are distinguished by their different actions, behavior, and the amount of capital they own; fields are shaped by the boundaries in which it separates them (Levina & Vaast, 2013; Orlikowski, 2000). This was important in identifying the factors that facilitated the collaboration among these distinct medical groups. In particular, the study drew on two emergent topics, boundary objects, and boundary spanning agents.

The second piece to the theoretical sensitivity important to this analysis was the concept of functional affordances (Markus & Silver, 2008). Functional affordances represent a relationship between a technology object and a specified user. This relationship identifies the extent to which a user can use this object given their capabilities and objectives(Markus & Silver, 2008). The existence of such affordances provides a user with a sense of the

potential of the technology object, and provides certain conditions for its appropriation. This analytic lens provided the researcher with a capability of examining the nature and use of IS within the hospital.

Such theoretical perspectives were used as a lens to better understand the work process and collaboration between the distinct practices (Bechky, 2003; Carlile, 2004; Greenhalgh & Wieringa, 2011; Lave & Wenger, 1991; Levina & Vaast, 2005, 2013; Orlikowski, 2000). Adapting this theoretical lens helped in making sense of the researcher's observations, and in developing an insight into boundary spanning activities within the organization. Finally, the different literature related to the system helped develop insights into the nature of the boundary object (ICIS), as well as the manner in which the IT group, advocated and facilitated the use of the IS. This section expands on each of these topics using various detailed examples found in the detailed interpretations of the empirical data (See table 8 in the next page).

Interview Excerpts	Sample Codes Generated (underlined)
How many different EHR systems do you currently use? Describe them Doctor: We use one system (ICIS) it basically contains everything we need. It is the best one I ever used throughout my medical career, which is a very long time. And no doubt there is a huge difference from ICIS and our past system. Thank god for ICIS.	**1. Functional Affordance** **Collaborative** (comprehensive System Functionality) and **Information Sharing** • The current system in use ICIS contains all the hospital's needs. A very satisfying well-developed system. • Single system use: Only using one system **2. Agent's (Doctor):** Doctor's Medical career duration: how long the physician has worked for. And had the experience to try different systems.
Could you describe the EHR system that is used in this hospital? Our EHR system is divided into 5 departments, which are all connected together. Powerchart is the hub, which has the basic patient information (opening a new patient's file, booking appointment). SurgNet covers the surgical unit, OR..etc. FirstNet cover the ER unit. Pathnet is about the labs, blood work, test results .. etc. and PharmNet covers the pharmacy department, includes all the medicine and how to dispense medication.	**1. Functional Affordance** **Collaborative** The system interconnects the different practices of the hospital. **Information Sharing** **2. System features** • Patient history update tool • Lab-work request and sharing tool • Task progress update tool • Shared interface and data • Lab-work report generation • Prescription request/ sharing tool **3. Agent Role** the different roles assigned to the different agents (doctors, pharmacy, Surgery). • Patient Diagnoses (doctors) • Medication Request (pharmacy)
What do you mean everything? What does it contain to cause this big overload? Doctor: It contains all the health records and tools in the hospital. The pharmacy and medical images like xray, scans, and so forth. Of course xrays are very huge images and cannot be compromised due to it precise nature. Therefore, the uploading and downloading of such images from different users persistently on the same system can cause a system overload. The hospital treats an extravagant number of patients per day. Patients coming	**1. System features** • Search tool • Patient history update tool • Lab-work request and sharing tool • Task progress update tool • Shared interface and data • Lab-work report generation • Prescription request/ sharing tool • Search tool **2. Functional Affordances:** **(Collaborative):** different users can access the system at the same time. And **collaborative** among practices within the hospital ***System Growth:*** the current system is hanging due to the larger amount it is processing. **3. Agent Role:** the different roles assigned to the different agents who

in and patients leaving or transferred and so forth… must be reported on the same system as well. So hanging is expected from how complicated and comprehensive the system is.	have different 4. **Goals/Objectives:** the doctor's goal to achieve his/her task. For example, one of the doctor's roles is to check images and x-rays and other functional related objectives such as **Reporting task** (Number of patients, Discharged, Transfer) **System Features:** Constraining of Access Number of (users, patients (infinite), downloads, uploads), and size of images
Nice! So it (*the notes taken during patient diagnoses)* is being logged basically live at that moment? Doctor: the doctor would put it the log and the course of treatment that is needed. The system will send couple of pop ups to advise him with the dosage amount of any certain medicine. The system can also detect if there is a conflict with two drugs being given to a patient. A lot of the drugs sometimes gets discontinued or stopped for a medical reason. And if a doctor is not aware of that certain information and prescribe that drug the system will prevent him from doing so.	**1. Agent (Doctor) Role** the different roles assigned to the different agents (doctors, pharmacy). • Patient Diagnoses • Medication Request **2. Goals/Objectives:** the doctor's goal to achieve his/her task. For example, one of the doctor's roles is to prescribe medication. • Input new data/notes • Update Patient records **3. Functional Affordances** **Decision-Making**: System Popup/System interprets/ System Alerts: The system generates different kinds of popups to advise or remind the user of additional needed information **3. Functional Affordances:** **Decision-Making** (Constraining system rules) The system will prevent users to prescribe a drug if it contradicts with another drug. System Detection and prevention: The ability of the system to detect and prevent error if conflict is found.
How do you use the ICIS system? Can you please describe your daily use of the system? Doctor: it is pretty straight forward. I look up a patient by searching for him or her in our system. By doing so, the system provides me with the current records available. The nurse as well provides me with the diagnoses and she would have logged it in the system. As I finish the check-up. I will log in my notes in the system.	**1. Agent (Doctor) Goals/Objectives** • Review Patient Records • Access Medical History • Check Patient Status • Physical Assessment check-up • Update Patient records **2. System features** • Patient Look-up • Patient history records • Shared Interface and data • Search tool • Patient Status • Constraining of access • Patient diagnoses recording tool • Patient history update tool **3. Functional Affordances:** **Information Sharing:** (Comprehensive system functionality) such as a search mechanism, accessing patient's records, logs, notes. **Collaborative** (Doctors and Nurses)

Table 8 Open Coding

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Publications

Journal of the Association for Information Systems (JAIS) December 2015

Theory Development Workshop

"Exploring The Concept of Behavioural Design Standards in the Context of Healthcare IS: A Functional Affordance-based Perspective"

November 2015

Decision Sciences Institute (DSI)

"Examining the Design and Use of Healthcare IS"

Conference on Information Systems Applied Research (CONISAR) November 2015

"A Practice Based Examination of Standardization, and its Relationship with the Design and Use of Healthcare IS"

The 21st Americas Conference on Information Systems (AMCIS) Augest 2015

"Investigating System Development Processes in Healthcare Organizations"

Key Strengths

- Familiar/Expert with routine applications of Mac OS X, MS Windows (Vista), MS Office, Oracle, C++, XML, VB, MS Visio , Adobe suite, Dreamweaver, and Web Design}
- Confident, committed and dependable
- Effective team integration
- Strong communication and conflict resolution skills