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# The Impact of Individual Learning on Electronic Health Record Routinization: An Empirical Study

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THE IMPACT OF INDIVIDUAL LEARNING ON ELECTRONIC HEALTH  
RECORD ROUTINIZATION: AN EMPIRICAL STUDY

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THE IMPACT OF INDIVIDUAL LEARNING ON ELECTRONIC HEALTH RECORD  
ROUTINIZATION: AN EMPIRICAL STUDY

MICHELE L. HEATH

**ABSTRACT**

Since the passage of the HITECH Act, adoption of electronic health records (EHR) has increased significantly. EHR refers to an electronic version of a patient's medical history. The adoption of EHR has potential to reduce medical errors, duplication of testing, and delays in treatment. However, current literature indicates that implementation of EHR is not resulting in the automatic routinization of EHR. Routinization refers to the notion that truly successful technological innovations are no longer perceived as being new or out-of-the-ordinary. The complexity of EHRs allow individual users to use these systems at different levels of sophistication. Research shows that healthcare professionals are using non-standard ways to use or circumvent the EHR to complete their work and are limited in EHR systems use. Further, although workarounds may seem necessary to physicians and are not perceived to be problematic, they can pose a threat to patient safety and hinder the potential benefits. Hence, we argue the EHR implementations are limited in their potential due to the lack of routinization. Any new technological innovation requires the physician support and willingness to learn about the system to move to the routinization phase of implementation. Hence, we draw from the literature on organization learning, individual learning, and routines to understand factors that influence EHR routinization.

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## **CHAPTER I**

### **INTRODUCTION**

Health care has encountered tremendous challenges and changes over the past decade. The health care industry agenda has evolved due to legislative changes, increased competition among providers, and savvier, more informed patients. Yet, change comes hard in a distinctive industry marked by autonomy and a hierarchical nature. Multiple, complicated changes are occurring simultaneously, including: the introduction of new forms of health-care delivery, such as accountable-care organizations; new payment models, such as pay-for-performance; new government policies, such as meaningful-use guidelines; and, new forms of technology, such as mobile patient self-management applications. The major test for most hospitals is the introduction of new technology such as electronic health records (EHRs). Similar to other industries, it is expected to take time for these technology-assisted developments and accompanying process changes to fully demonstrate value (Sherer, 2014). Hospitals are starting to transition the discussion to determine whether technology will support the models of care delivery that will achieve broader policy goals: safer, more effective and more efficient care (Bitton, 2012). In health-care service systems, stakeholders often have conflicting goals, including quality-

of-life, accessibility, trust, safety, convenience, patient-centeredness, and communication. Researchers have concluded that widespread adoption and meaningful use of EHR technology rely on the successful integration of health information technology (HIT) into clinical workflow (Gesulga, Berjame, Moquiala & Galido, 2017).

Since 2004, increased governmental incentives and significant changes in the health-care information technology (IT) industry have attracted interest from information systems (IS) researchers as evidenced by publications in leading journals (Romanow, Cho, & Straub, 2012). However, most research papers have focused on such common topics as IT adoption, resistance, and privacy. One of the biggest challenges health-care organizations face is how to use technology to improve the delivery of health-care services. Hospitals are transitioning the discussion to determine whether technology will support models of care delivery that will achieve broader policy goals of safer, more effective, and more efficient care (Bitton, Flier, & Jha, 2012). Researchers must move beyond IT implementation issues and focus on the facilitation of integration, team orientation, long-term use, and cost-conscious care.

In 2009, the industry received a big push from the federal American Recovery and Reinvestment Act (ARRA). A provision within the ARRA—the Health Information Technology for Economic and Clinic Health (HITECH)—included \$19 billion to encourage use of electronic health records (EHRs). The act included both incentives and penalties to persuade physician groups and hospitals to implement EHRs. An EHR is defined as digitally stored health-care information throughout an individual's lifetime with the purpose of supporting continuity of care, education, and research (Detmer, Bloomrosen, Raymond, & Tang, 2008). The widespread adoption of EHRs promises many benefits,

including improvements in quality and a concomitant reduction in medical-error rates, enhanced cost effectiveness, and greater patient involvement in health-care decision making (Ford, Menachemi, & Phillips, 2006). The goal of the health-care industry is to make EHRs operable so as to contribute to more effective and efficient patient care by facilitating the retrieval and processing of clinical information about a patient across different sites and between providers. Notable drivers for implementation include financial incentives and penalties for hospitals and providers based on meaningful use. Meaningful use is the set of standards defined by the Centers for Medicare & Medicaid Services (CMS) Incentive Programs that governs use of EHRs and allows eligible providers and hospitals to earn incentive payments by meeting specific criteria (Shrestha, Sarnikar, & Timsina, 2013). EHRs are a vital part of the transition to computerized documentation (Sheridan et al., 2012). The health-care industry has seen a gradual progression toward EHR adoption as the government continues to push hospitals and physicians, using incentives and reimbursement as a leverage to press forward.

Early data on the impact of HITECH on hospital EHR adoption rates have been generally positive, but more work is needed to achieve universal adoption (DeRosches et al., 2008). However, many hospitals have yet to move beyond a basic EHR system. Only 44% of hospitals report using what can be defined as a basic EHR system, and although 42.2% of hospitals meet all federal stage 1 meaningful-use criteria, only 5.1% could meet the broader stage 2 criteria (Jamoom, Patel, Furukawa, & King, 2014). In 2016, 34.8% of hospitals reported using a fully functional EHR system, defined as one that includes such capabilities as e-prescribing, electronic charting, and integration with testing and imaging centers. For comparison, the federal Office of the National Coordinator for Health

Information Technology reported that, in 2015, 95% of all eligible, critical access hospitals had demonstrated meaningful use of certified health IT systems (American Institutes for Research, 2016). Lagging behind were some states with large rural areas (e.g., Alaska, Hawaii, Texas) and office-based physicians, only 56% of whom had demonstrated meaningful use.

Research in the health-care context must begin by reflecting on what is distinctive about the industry and how such distinctions should inform our research and hypotheses (Fichman, 2011). Health-care organizations have clearly defined lines of power, authority, and flow of information, and the actors within, physicians, have a powerful influence on whether technology is adopted. Yet, the health-care industry is 10-15 years behind other industries in IT adoption (Ronanow, 2012). Fichman, Kohli, and Krishnan (2011) stated, “The health care delivery setting is characterized by a tension between the need for orderly routines and the need for sensitivity to variation in local conditions” (p. 423). Routines are critical when dealing with life-and-death situations, however, health-care organizations experience tension between routines and factors within the environment. Most hospitals understand the importance of effective learning and adaptation surrounding health-care IS implementation and use. The process of learning establishes the best way to adapt both technology and the organization to achieve a good fit between the capabilities technology offers and its desired use. The implementation of EHRs is the tipping point, meaning most organizations have a way to go before EHRs no longer perceived as being new or out-of-the-ordinary within health-care organizations. Individual learning (IL) and adaptation in an organization context plays a significant role in developing routines and fostering continuous learning in the health-care environment. Tsang (1997) argues that there is a



close relationship between individual learning within an organization context, and the two concepts should be integrated.

### **1.1 Statement of the Problem**

Improving the quality of medical care has become an important policy goal (Kvedar, Coye, & Everett, 2014). In examining the health records of inpatient admissions in 2008, the U.S. Department of Health and Human Services Office of the Inspector General reported 180,000 deaths due to medical error among Medicare claimants alone (Hyman & Silver, 2012). Evidence suggests inadequate, inappropriate, or excessive care is a major problem (Adler & Newman, 2002). A review of 900 studies from 1990 to 2009 across 104 countries, reported compliance with standard treatment guidelines was 40% among public facilities and less than 30% in private, for-profit facilities. In recent years, key political actors and advocacy groups have argued for increased use of IT to improve health-care quality, reduce medical errors, and lower delivery costs (Ferlie & Shortell, 2001; McGinnis, Williams-Russo, & Knickman, 2002).

EHR adoption rates continue to progress as hospitals deal with a multitude of issues related to technology adoption, such as physician resistance, technology interoperability, and change-management issues. Less than a decade ago, 9 of 10 doctors in the U.S. updated patient records by hand, storing them in color-coded files (Gibbing & Wickramasinghe, 2018). The introduction of EHR in a hospital environment has clearly disrupted physician and staff routines, and physicians have expressed reservations that EHR systems will not fully meet their needs (DesRoches et al., 2008), or worse, will result in decreased clinical efficiency and effectiveness (Simon et al., 2007). Several studies have demonstrated that the introduction of new medical technology can trigger the disruption of routines in health-care settings (Barley, 1986; Edmondson, 2004). In fact, EHR adoption will have little

impact on healthcare delivery, if they are not well integrated into the daily workflows of physicians (Agarwal et al., 2010; Goh, Goa & Agrawal, 2011).

Despite the ubiquity of routines in care delivery and the centrality of routines to the fundamental work hospitals do, there is a surprising paucity of rich, in-depth studies of routines in health care in the literature (Gao, 2011). Several studies have underscored the disruptions caused by technological innovations in health-care settings. Barley (1986) examined how organizational structures changed with the introduction of CT scanners and radiology imaging devices respectively. Edmondson et al. (2004) investigated how a new cardiac surgery technology disrupted existing routines and how team learning occurred. The disruption caused by new technologies can lead to productivity losses or even a higher level of errors (Embi, Efthimiadis, Thielke, Hedeem, & Hammond, 2013). Embi et al., 2004; Weir, Hurdle, Felgar, Hoffman, Roth, & Nebeker, 2003). At the level of institutional structures, there may be constraints or drivers, such as laws, codes, and expectations as to how a good clinician should behave (Greenhalgh, 2008). The presence of wider environmental forces could create incentives or disincentives for particular routines. At the organization level, there may be a variety of problems, such as: the routine is under-resourced or poorly coordinated; the technology is inadequate; the new routine conflicts with other, more established or critical routines; key actors lack the necessary autonomy; or leaders create a weak or inappropriate framing for the routine and fail to invest in team training (Becker & Zirpoli, 2008).

Hence, the initial, negative impact of the disruption usually fosters resistance among physicians in several ways such as 1) physicians use non-standard ways to complete EHR tasks (Mead, 2006); 2) physicians circumvent the EHR to complete their work

(Flanagan et al., 2013); 3) physicians determine that limited EHR systems use is sufficient (Poissant, Pereira, Tamblyn, & Kawasumi, 2005); and 4) physicians abandon or bypass EHR system completely (Greenhalgh et al., 2008). This study addresses gaps in the literature as to how individual learning can lead to routine use of EHR for hospitals to achieve the goals set forth by meaningful use under the HITECH Act.

## **1.2 Purpose of the Dissertation**

This proposed, theory-based, empirical research leverages key accumulated knowledge from health care, IT, and individual learning (IL) in the organization context centered on EHR routinization. This study acknowledges that the EHR system is owned by the hospital. EHR systems are owned by the organization and not the individual physicians. Physicians control patient information and working processes in EHR environment. Hence, physician individual learning of the EHR system is important to routines. Physicians are referred to as professionals, professional autonomy is typically granted. Professional autonomy is defined as “professionals having control over the conditions, processes, procedures, or content of their work” (Walter & Lopez, 2008), which will not be possessed or evaluated by others. Physicians are self-regulated and trusted to use his or her judgement to deliver services patients. Professional autonomy plays a very important role in the working practices of physicians (Boonstra, 2010). Physicians can determine whether a routine is formed or becomes repetitive. Routines will assist physicians to cope with pervasive uncertainty under the constraint of bounded rationality because they can be used to save on mental efforts and thus preserve limited capacity required to deal with non-routine events (March & Simon, 1958). Workflows play a central role in care delivery and are directly linked to physicians (Militello, Arbuckle, Saleem, Patterson, Flanagan,

Haggstrom, Doebbeling, 2014).). Agarwal (2010) suggests that studying routinization at the physician level is a promising approach.

As noted, the significance of routines has been studied extensively by scholars in multiple fields (see Becker, 2004). Routines are regular, repetitive action patterns performed by multiple actors across time and space (Feldman & Pentland, 2003), are frequently recognized as a key organizational capability, offering competitive advantage (Winter, 2003), and have been shown to influence performance outcomes (Cohen & Bacdayan, 1994). The complexity of EHRs allow individual users to use these systems at different levels of sophistication (Flanagan, 2013). Research shows that health care professionals are using non-standard ways to use or circumvent the EHR to complete their work and are limited in EHR systems use (Flanagan et al., 2013). Further, although workarounds may seem necessary to physicians and are not perceived to be problematic, they can pose a threat to patient safety and hinder the potential benefits (Koppel et al., 2008). Hence, this research study argues that EHR implementations are limited in their potential due to the lack of routinization.

Zmud and Saga (1994) put forth a causal model to explain information technology routinization. The construct of routinization was described by three variables: use perceived as being normal; standard use; and administrative infrastructure development. The authors also linked user acceptance and two other variables: frequency of use and management intervention. Zmud and Apple (1992) showed that early adoption of a new technology provides more opportunities to use it and more time to adjust the administrative infrastructure to facilitate learning the technology. Zmud and Saga (1994) acknowledge routinization of a technology has both positive and negative consequences. The positive

points are there is increased use of the technology and the technology becomes part of the daily work routine. The negative points arise from that fact technology becomes entrenched in the culture, making it hard to introduce new technologies or work processes. This study will carry forth and build on Zmud and Saga's (1994) concept of routinization.

### **1.3 Research Question**

This proposed research argues that IL is important when instituting routinization in hospital environments. Individual learning is a basis of learning at an organizational level (Yang 2009; Campbell & Armstrong 2013). Individual learning is equally as important for an organization as it is for the workers themselves. In addition, individual learning is key to performance for knowledge-intensive activities such as routinization (Kankanhalli, Pee, Tan & Chhatwal, 2011). In summary, to address the identified gap, this study will attempt to answer a number of related research questions within the context of EHR routinization and IL, including:

- 1) Investigate individual learning impact on routine use of EHR.
- 2) Investigate the moderating relationship of environmental turbulence between individual learning and routine use of EHR.

With those research questions in scope, Section II highlights important findings from the literature related to organization learning, individual learning and routine. This literature informs suggested Research Model and Hypothesis Development in Section III. Section IV details methodologies deployed to test the hypotheses. Section V provides results and analysis. Section VI offers discussion of the results along with research and practical implications. Section VII describes known limitations and future research, both as a result

of those limitations and of direct findings from this research. Concluding remarks are presented in Section VIII.

#### **1.4 Significance of the Study**

EHR is a focal point for most U.S. hospitals. The National Academy of Medicine has qualified EHR as an essential technology for health care (Kellerman & Jones, 2013). EHRs are adopted by hospitals to provide accurate, comprehensive, and up-to-date information by which health-care professionals may deliver quality services (Wu et al., 2013). The pervasive adoption of EHRs promises many benefits, including improvements in quality and a concomitant reduction in medical-error rates, enhanced cost effectiveness, and greater patient involvement in their health-care decision making (Ford et al., 2006). Patients can benefit from online access to EHRs to review records and discharge plans, to arrange appointments, and to provide doctors and health-care practitioner's access to their medical history. Doctors can order labs, consults, procedures, and prescriptions and view patient medical and medication histories. Nurses can document patient information more effectively and generate reports more efficiently. Hospitals and physician groups will benefit from EHRs through improvements in the integrity and expediency of clinical information received, usability, malpractice protection, and evaluation and management compliance.

A collective body of research into EHR implementation shows most projects do not sustain beyond the experimentation phase (Currie, 2012). Therefore, identifying factors that influence EHR adoption is key to ensuring its optimal integration and, ultimately, allows measurement of its adoption within the health-care system and, by extension, the patient population. The factors pertaining to EHR users and the hospital work environment

have to be considered because many previous EHR projects failed due to the lack of its integration into practices and organizations (Berner, Detmer, & Simborg, 2005). Prior studies on factors affecting EHR adoption in health-care settings have traditionally focused on a single aspect of this multidimensional phenomenon (Lapointe & Rivard, 1999). Studies have assessed the adoption determinants either at the organizational/ systemic level or at the professional/individual level. With regard to individual factors, several studies on barriers and facilitators to physicians' EHR adoption have been conducted (Menachemi, Burkhardt, Shewchuk, Burke, & Brooks, 2006). Other studies have explored factors associated with nurses' intention to adopt EHR (Mohd & Syed Mohamad, 2005). Factors affecting the readiness of health-care organizations to implement interoperable IS have also been studied (Courtney, Alexander, & Demiris, 2008). Research findings conclude that EHRs failure can be attributed primarily to physicians' frustration with the system's functionality, physician lack of motivation to learn the system and the difficulty physicians experienced in integrating the technology into their established workflows (Goh, Gao & Agarwal, 2011).

EHR adoption will have little impact on health care delivery, if they are not well integrated into the daily workflows of physicians (Agarwal et al., 2010; Goh et al., 2011). EHR systems implement formalized business processes in a variety of health care settings. Though EHR implementation has been on rise, studies find that the result of EHR implementations have been mixed. Recent research shows that health care professionals often use non-standard practices and work arounds that circumvent the EHR system to complete their work. Although such workarounds may seem necessary to physicians and

are not perceived to be problematic, they can pose a threat to patient safety and hinder the realization of the benefits of EHR system implementation.

This research argues that EHR routinization is key to achieving the promised benefits of EHR implementations. In this research, EHR routinization is defined as the regular use of EHR systems by health care professionals, whereby the EHR system is no longer perceived as being new or out-of-the-ordinary. For any new technological innovation such as EHR to be routinized, physicians support as well as ability and willingness to learn about the system are critical. Further, this research argues that physicians use non-standard practices because they either do not know how to achieve the task using the EHR system or they do not know how to complete a task efficiently using the EHR system. Hence, this research draws from the literature on organizational learning and individual learning. Specifically, this research examines the impact of physicians' individual learning on EHR routinization. Further, (i) given the dearth of empirical research on the factors that influence physicians' individual and social learning in the context of EHR routinization and (ii) the need to understand the antecedents of physicians' individual learning to be able to provide meaningful guidance to researchers and practitioners dealing with EHR routinization challenges, this research studies the antecedents of individual and social learning by physicians. Furthermore, we posit that environmental turbulence has a moderating influence on the relationship between individual learning and EHR routinization.

EHRs are a vital part of the transition to computerized documentation (Sheridan et al., 2012). However, physicians must take their interest a step forward and commit to their individual learning that will allow them to influence routinization. Routines involve people



and knowledge; people must apply knowledge to particular situations (Edmondson, 2000). Researchers suggest that routines and process changes will be more successful if physicians invest in learning activities (Fine & Porteus, 1986). This research proposes that a physician's intentions or willingness to learn is an important indicator of the potential success and effectiveness of an information system in a medical environment. Behavioral intent to begin using a technology can be distinguished from intent for continued use in several ways. For example, medical practitioners have historically presented high resistance to IT perceived as inefficient (Tulu, Burkhard, & Horan, 2006), although such resistance appears to be eroding as technologies become easier to use (Boudreau & Robey, 2005). Unfortunately, the evidence to support EHR routinization is limited (Sheridan et al., 2012). Currently, there are very few studies on routines, workflow and process changes, which are crucial for a successful implementation (Goldzweig, Towfigh, Maglione, & Shekelle, 2009). Therefore, we posit that there is a paucity of research related to EHR routinization. This research study defines routinization as the notion that truly successful technological innovations, are no longer perceived as being new or out of the ordinary (Ritti & Silver, 1986; Saga & Zmud, 1993; Zucker, 1977).

### **1.5 Theoretical Frameworks**

This proposed dissertation is informed by three theoretical frameworks, IL theory, OL theory, and IT continuance. Each theory will be discussed in turn. It is important to note that this study will look at individual learning in organization context. Hence, the need to incorporate OL theory.

Hospital workflow of the 21st century will be radically different, and the change will come about because of EHR (Baron, Fabens, Schiffman, & Wolf, 2005). Physicians are faced with challenges on how they are able to adapt to change, elicit tacit knowledge,

and construct histories of insights and catalog them. Individual learning is an important part of a physician job. EHR changes the way hospitals do business, and technology creates a new workflow system for physicians. Physicians must reconcile current habits and values with the changes introduced by EHR systems.

Workflow are standard processes that accompany the EHR system. Workflow is often characterized in terms of the pattern of actions clinicians utilize to perform routine tasks and generate results (Lee, Cain, Young, Chockley & Burstin, 2005). In several surveys of physicians with EHR systems, physicians expressed a number of concerns relevant to EHR implementation and workflow such as maneuvering through the different interface templates and forms, and inputting data into an EHR system while interacting with patients (Unertl, Weinger, Johnson, & Lorenzi, 2009). Workflows typically disrupt the hospital environment because physicians quickly realize that there is a new way of completing tasks and activities in their daily environment (Aarts, Ash & Berg, 2007). Physicians must exemplify the willingness to learn the new workflow. Because most task require a significant amount of individual learning. Physicians can learn through many different channels such as traditional learning, seeking information from others, or using manuals to acquire knowledge.

The complexity and usability problem associated with EHRs results in physicians having to allocate time and effort if they are to master them (Boonstra, 2010). Physicians have to learn how to use the EHR system effectively and efficiently which they see as a burden. The lack of technical skills leads the physician to regard EHR system as extremely complicated. Physicians have a central role in the use of the EHRs, as they are who provide much of the information that the systems handle in their automated processes (Castillo,

Martínez-García, & Pulido, 2010). EHRs systems require a fair amount of user knowledge and aptitude, which can cause hardships for those who weren't trained to use the technology (Bhattacharjee & Hikmet, 2007). Physicians recognize that there is a learning curve as it relates to EHR. Most physicians simply don't believe they have time to learn an entirely new system and use it effectively, immediately.

Research has shown that it's difficult to achieve routinization in health care for the following reasons:

- Physicians don't know how to use the system (Ash, Berg & Coiera, 2004).
- Physicians don't appreciate the need to use EHR in standardized ways (Walsh, 2004).
- Most physicians simply don't believe they have time to learn an entirely new system and use it effectively, immediately (Boonstra, 2010).
- Most physicians consider EHRs to be challenging to use because of the multiplicity of screens, options and navigational aids (Ludwick & Doucette, 2009).
- Physicians also need to spend time and effort on learning how to use an EHR system (Miller & Sims, 2004).

However, the demands and pressures of delivering office-based care may not afford them the time to learn the system (Simon et al., 2007). Based on the research, we use individual learning as a theoretical lens to understand what factors will lead to individual learning and impact routinization.

Individual learning refers to the knowledge acquisition, which can occur only when individuals have both the ability ("can do") and the desire ("will do") to acquire new knowledge. This research study will assess a physician ability, desire and willingness to

acquire new knowledge related to the EHR system. Learning is at the heart of a company's ability to adapt to a rapidly changing environment (Popper & Lipshitz, 2000). Learning takes place when disjuncture's, discrepancies, surprises, or challenges act as triggers that stimulate a response (Marsick & Watkins, 2003). Research suggests that individuals select a strategy or action based on their cognitive and affective understanding of the meaning of the initial trigger (Marsick & Watkins, 2003). This study integrates individual factors from a symbolic cognition and behavioral perspective. Symbolic cognition research examines the way people absorb information from their environment, arrange it mentally, and apply it in everyday activities (Kankanhalli et. al, 2010). Symbolic cognition view includes the following factors: absorptive capacity, knowledge sourcing initiative and learning orientation. Behavioral research examines an individual desire or want that energizes and directs a goal-oriented behavior (Huitt, 2001). Behavioral view includes the following factor: motivation to learn. Learning at the individual level is the way in which people obtain knowledge and skills (Marsick & Watkins, 2001), through the promotion of inquiry and dialogue and the creation of continuous learning opportunities (O'Neil, Wainess, & Baker, 2005). The unit analysis we seek to investigate is physicians (individual level) because physicians control the workflow process and research suggests that physician level is a promising approach to the study of routinization (Agarwal et al., 2010).

Routinization has been associated with IT continuance in the IS literature. IS continuance has been studied both at the organizational and individual level. *Routinization* refers to modifications that occur within the workflow such that they are no longer perceived as new processes (Saga & Zmud, 1993). As mentioned, IS continuance is also studied at the individual level. IS continuance behavior refers to a usage stage when IS use

transcends conscious behavior and becomes part of the normal routine (Bhattacharjee, 2001). IT continuance at the individual level refers to sustained use of an IT by individuals over the long-term after their initial acceptance (Bhattacharjee, 2001).

Over the last 10 years, IS has seen a growing body of research on IT continuance, and more generally on IT post-adoptive behaviors (Ahuja & Thatcher, 2005; Bhattacharjee, 2001; Bhattacharjee & Premkumar, 2004; Jasperson, Carter, & Zmud, 2005). The essential argument is that continuing IT use is fundamentally intentional behavior driven by conscious decisions to act (Bhattacharjee, 2001). Most IT continuance is seen as a series of decisions to continue using IT (Bhattacharjee, 2001). This study will argue that IL is far more than decisions related to continue use. We will put forth a model that represents factors that influence IL factors, which leads to EHR routinization. Most IT continuance literature applies to the individual level. IS literature on continuing IT use emphasizes the role of habitual behavior that does not require conscious intention while remaining faithful to the theoretical tradition of planned behavior and reasoned action (De Guinea & Markus, 2009). However, we argue that researchers must go beyond emotions, habits, and beliefs to explain individual IT continuance. IL factors play an important role on the long-term use of an EHR system. This research study will focus on physicians learning in the organizational context to understand how to create routines. We will build on the concept of routinization in the health-care context.

## **1.6 Summary and Organization of Remaining Chapters**

This proposed study has important implications both for future research and practice. This research contributes to the literature on health care by using IL as a lens to understand routinization in the EHR context. This research also contributes to the theory of IT continuance by examining it in a unique and important context, EHR. The initiation

and adoption of EHR has been particularly challenging due to the complexity of dealing with multiple stakeholders and public policy guidelines. Despite the many challenges, the extant literature has paid scant attention to the role of individuals in creating routines within an organization. Using the lens of individual learning, I theorize how factors of individual learning- Absorptive Capacity Knowledge Sourcing Initiative, Learning Orientation, Motivation to Learn—can be applied within a health-care setting to lay strong foundations for successful EHR routinization. My work, for the first time in EHR literature, uses IL to shed light on the process that can contribute to successful routinization. Further, this research has important implications for hospitals investing in EHR systems and wanting to take advantage of the billions of dollars in incentives the federal government has made available for hospital EHR adoption.

This dissertation will investigate individual learning impact on EHR routinization in organization context. It is organized as follows: Section II highlights important findings from the literature related to EHR adoption and resistance, IT continuance, IL and OL. This literature informs the suggested Research Model and Hypothesis Development in Section III. Section IV details the methodologies deployed to test the hypotheses. Section V provides results and analysis. Section VI offers discussion of the results along with research and practical implications. Section VII describes known limitations and future research, both as a result of those limitations and of direct findings from this research. Concluding remarks are presented in Section VIII.

## **CHAPTER II**

### **LITERATURE REVIEW**

This chapter summarizes the literature relevant to the intended research. The sections in this review are: electronic health records (EHRs), organizational learning (OL), individual learning (IL), organization routines, and individual routines. While research into EHR adoption is mature, applying IL and OL to EHR provides an appropriate and effective framework for this study. Health care IS researchers have learned great insights from EHR adoption and resistance. EHR adoption literature provide a rich backdrop for research in routinization. This study will carry forth and build on literature on routinization and individual routines. Saga and Zmud (1993) were first to address the concept of routinization, the phase that potentially follows the acceptance of the new technology system. IL factors play an important role when investigating long-term use of an IS. To address the identified gap, this study will attempt to answer the following research objectives within the context of EHR routinization and IL:

- Investigate individual learning impact on routine use of EHR.

- Investigate the moderating relationship of environmental turbulence between individual learning and routine use of EHR.

## **2.1 Electronic Health Records**

The National Academy of Medicine has qualified EHRs as an essential technology for the health-care industry (Kellerman, 2013). EHRs are adopted by hospitals and medical practices to provide accurate, comprehensive, up-to-date information for clinicians to deliver quality health-care services (Wu et al., 2013). Adoption of EHRs promises other benefits, including a reduction in medical error rates, enhanced cost effectiveness, and greater patient involvement in health-care decision making (Ford, 2006). Patients can benefit by accessing their EHR online, arranging appointments, and providing electronic access to medical histories from all providers. Through EHRs, doctors may track patient histories and medications and write e-prescriptions while nurses can document patient information and generate reports more efficiently. The benefits of EHR for hospitals and medical practices include: improvements in the integrity of clinical information; usability; malpractice protection; and, evaluation and management compliance.

Physician resistance and dislike for EHRs has sparked a great deal of research attention. While EHRs are a vital part of the transition to computerized documentation, hospitals have had to deal with physician resistance since the inception of EHRs (Sheridan et al., 2012). The health-care industry's next step is to examine those factors that influence an organization's continued use of EHR. Continued use of medical IT is an important indicator of the potential success and effectiveness of an IS in a medical environment. Behavioral intent to begin using a technology can be distinguished from intent for continued use in several ways. For example, medical practitioners have historically



presented high resistance to information technologies perceived as inefficient (Lee et al., 2005), although such resistance appears to be eroding as technologies become easier to use (Schonfeld, 2005).

EHR is a policy-driven technology standard implemented in the U.S. through both meaningful use and regulation. It is important to understand the definition of EHR adoption and the role of the government in ensuring compliance. Following an overview and history of EHR adoption, key research is discussed to: provide a progression of EHR adoption; emphasize the criticality of EHR to the health-care industry; and, inform the basis for this research.

## **2.2 Background**

EHR is defined as digitally stored health-care information throughout an individual's lifetime with the purpose of supporting continuity of care, education, and research (Detmer & Bloomrosen, 2008). With the benefits of EHRs already firmly established, the goal of the health-care industry is to make EHRs interoperable so as to contribute to more effective and efficient patient care by facilitating the retrieval and processing of clinical information about a patient from different sites (Ford, 2006).

President Obama signed the Health Information Technology for Economic and Clinical Health (HITECH) Act in 2009 and supported the act with \$19 billion from the American Recovery and Reinvestment Act to encourage the health-care industry's use of EHRs. Notable drivers for implementation include financial incentives for hospitals and providers who demonstrate meaningful use and penalties for those who do not. Meaningful use is the set of standards defined by the Centers for Medicare & Medicaid Services (CMS) EHR Incentive Programs, which governs the use of EHRs and allows eligible providers and hospitals to earn incentive payments by meeting specific criteria (Shrestha, 2013).

Meaningful use is divided into three notable stages. Stage 1 began in 2010 and focused on promoting adoption of certified EHRs. Finalized in 2012, stage 2 increased the thresholds of criteria compliance and introduced more clinical decision support, care-coordination requirements, and rudimentary patient engagement rules. Stage 3 focused on robust health information exchange as well as other, more fully formed meaningful use guidelines introduced in earlier stages (Grossman, 201).

Eight years into operationalizing this legislation, a new administration took office. In December 2016, CMS released a final rule with comment period regarding changes to meaningful use (Knutson, 2016). The changes apply to eligible hospitals and critical access hospitals, including those eligible to participate in both the Medicare and Medicaid Meaningful Use programs. After much debate and many complaints from the medical community, the legislation was updated and revised in 2016.

Under the new requirements, there is no longer a designation between core and menu measures. All eligible professionals must report on the modified stage 2 mandatory objectives for 2015 through 2017. There are exclusions and specifications for providers depending upon which stage of meaningful use the provider was scheduled to report in years 2015 and 2016. Also, by 2018, all providers will be required to move to stage 3 meaningful use. The meaningful use program will become one component of the Merit Based Incentive Program, which will take effect in 2019 based on 2017 reporting.

CMS recently released a final rule, specifying the criteria eligible professionals, hospitals, and critical access hospitals (CAHs) must meet to continue to participate in EHR incentive programs. The rule's provisions encompass EHR incentive programs through 2018 and beyond.

Meaningful use stage 3 is the third phase of the meaningful use EHR incentive program. CMS and the Office of the National Coordinator for Health IT (ONC) published the final rule on meaningful use stage 3 on October 6, 2015. Despite the requirements set forth by stage 3, a new law, the Medicare Access and CHIP (Children's Health Insurance Program) Reauthorization Act will eventually modify the meaningful-use program as a means to push forward with value-based reimbursement. Meaningful use stage 3 includes all requirements physicians must meet to receive incentives and to avoid any penalties. In this program, physicians must meet the following eight objectives (cms.gov, 2017):

1. Protected health information (PHI): Eligible physicians must attest to conducting a security risk analysis to assess vulnerabilities to PHI that could lead to data breaches. In addition to the fact that the Health Insurance Portability and Accountability Act (HIPAA) requires practices to perform risk analyses and other security audits, the requirements attached to meaningful-use objectives make it a must-have in order to receive incentives.

2. Electronic prescribing: Eligible physicians are required to have more than 80% of their permissible prescriptions queried for drug formulary and transmitted to pharmacies electronically.

3. Clinical decision support (CDS): For this objective, two different measures are available for eligible physicians. The first measure covers implementation of five CDS interventions. The second relates to the use of drug-drug and drug-allergy interaction checks during the reporting period, which are available within a certified EHR platform.

4. Computerized provider order entry: Eligible physicians are required to meet three different measures for medication, lab and diagnostic imaging orders.

5. Patient electronic access: To encourage patient engagement, stage 3 includes an objective in which eligible physicians must provide access to EHRs to more than 80% of patients, with the option to view and download records. In addition, eligible physicians must offer the option to receive educational data from more than 35% of their patients.

6. Coordination of care through patient engagement: The three measures in this objective encourage patients to actively engage in their care. The first measure requires physicians to have more than 25% of patients interact with their EHR. The second requires that more than 35% of patients receive a secure digital communication from a care provider. The third focuses on encouraging the collection of patient generated health data from fitness trackers or wearable devices from more than 15% of patients. Eligible providers must attest to all three measures but meet thresholds for two of the three.

7. Health information exchange: The three measures in this objective encourage interoperability. The first measure requires that more than 50% of care transition and referrals include the exchange of care records, such as continuity of care documents (CCD), electronically. The second requires physicians who are seeing a patient for the first time to receive care documents electronically from a secondary source more than 40% of the time. The final measure requires physicians to use e-prescribing services to reconcile medication lists from online sources with their own for more than 80% of new patients they see. Eligible providers must attest to all three measures but meet thresholds for two of the three.

8. Public health and clinical data registry reporting: In this objective, providers must choose three out of five available EHR reporting destinations to which they will periodically submit data. Reporting options include an immunization registry, syndromic surveillance cases, a public health registry, and a clinical data registry.

A description of these objectives is critical to understanding the breadth and capabilities of EHR systems promoted under the HITECH Act. The next section focuses on key findings in EHR adoption, a discussion that will set the stage for this study's focus on OL, individual learning, social learning and EHR routinization.

### **2.3 Key Findings in EHR Adoption**

Hospitals have made substantial investments in EHR software. Since the inception of EHR, EHR adoption literature focused on barriers to adoption of EHR-related hardware systems and software. The main barriers identified include perceived cost, poor project planning, lack of accountability, and absentee sponsors (Boonstra, 2010). Theories on use, such as the unified theory of acceptance and use of technology (UTAUT), were used widely as theoretical lenses in which to understand use-related problems. One barrier to meaningful use is resistance from doctors and nurses. This section presents key findings in the area of EHR adoption and resistance.

An increasing body of knowledge on EHR implementation shows a majority of projects do not sustain beyond the experimentation phase (Currie, 2012). Therefore, identifying factors that influence EHR adoption is key to ensuring its optimal integration within the health-care system and patient population. Factors related to users and their working environment must be considered as many previous EHR projects have failed due to a lack of integration into practices and organizations (Berner, 2005). Prior studies on factors affecting EHR adoption in health-care settings have traditionally focused on a single aspect of this multidimensional phenomenon (Lapointe, 2005). Studies have assessed adoption determinants either at the organizational/systemic level or at the professional/individual level. With regard to the individual level, several studies have focused on barriers to physician EHR adoption (Menachemi, 2006) while others have

explored factors associated with nurses' intention to adopt EHR (Dillon, 2005). Factors affecting the readiness of health-care organizations to implement interoperable IS have also been studied (Synder-Halpem, 1999).

Additional studies have explored EHR adoption determinants at different levels without considering their possible interdependence. For example, Simon et al. (2007) conducted a survey on EHR adoption by medical practices in Massachusetts, exploring organizational, professional, and technological factors. Results showed that practices with seven or more physicians, hospital setting, and teaching status were significant predictors of EHR adoption. Still, EHR adoption by health-care professionals working in a specific setting might be influenced by the characteristics of that organization, which implies a hierarchical or clustered data structure. Lapointe (2005) conducted a multidimensional analysis on the adoption of hospital information system by nurses and physicians using a multiple case study. Lapointe's findings indicated that individual decisions to adopt the system or not may conflict with the organization's decision to implement the system.

Initial data on the impact of HITECH on hospitals' EHR adoption rates have been generally positive, but more work is needed (DeRosche et al., 2008). While adoption rates have been positive, many hospitals have not moved beyond a basic EHR system. In 2012, over three quarters of physicians had adopted some type of EHR (Adler-Milstein et al., 2015). Physician adoption of EHRs with at least basic computerized functionality has grown since passage of the HITECH Act, reaching 40% in 2012 (Jamoom & Patel, 2014). According to a report published by the National Center for Health Statistics (NCHS), which measured physician use of EHR systems nationwide, EHR adoption rates stand at 55% (Jamoom et al., 2014). Only 44% of hospitals report using what may be defined as at least

a basic EHR system, and although 42.2% meet all of the federal stage 1 meaningful-use criteria, only 5.1% could meet the broader set of stage 2 criteria (Jamoom & Patel, 2014). While EHR adoption has increased steadily since 2010, it is unclear how providers that have not yet adopted will react now that federal incentives have converted to penalties. Sajedi and Kushniruk (2009) and Hamid & Cline (2013) endorsed the need to identify factors that affect a providers' intent to adopt EHR. The identification of acceptance factors and perceived barriers is an important step in designing interventions to facilitate EHR success among providers.

One barrier to meaningful use is resistance from doctors and nurses. Research also shows that doctors and nurses resist using EHR systems despite understanding its potential benefits (Flanigan et al., 2008). Almost three-quarters of doctors say they prefer their personal clinician notes over computer-based entry and filing systems, and 60% of those who have installed EHRs continue to keep paper records (Flanigan, 2013). The IS literature has extensively documented the impact of user resistance to information system on system use. Although typically framed as neither good nor bad (Ferneley & Sobreperéz, 2006; Lapointe & Rivard, 2005), resistance does not resonate well with the virtue of environments in which employees identify themselves with organizational norms and values (McGrath, 1982; Willmott, 1993). A common conception, therefore, is that user resistance needs to be mitigated in the interest of yielding functional rather than dysfunctional outcomes. At times, it is a means for users to convey the existence of problems with the IT or with its effects; in such instances, resistance is functional. At other times, however, resistance "can be destructive, because it generates conflict and ill-will" (Markus, 1983, p. 433).

IS users react in different ways to a new technology (Stein, Newell, Wagner & Galliers, 2015). They may reject it completely, partially use its functions, actively resist it, unwillingly accept it, or embrace it fully. Within the IS adoption and implementation literature different terms are used to describe different aspects of an individual's decision not to use a certain technology (Wallace & Sheetz, 2014). Lapointe and Rivard (2005) describe the individual's technology usage decision as follows: users themselves or in a group will first assess the technology in terms of the interplay between its features and individual- and/or organizational-level initial conditions. Furthermore, they make projections about the consequences of the potential use of the technology. This initial negative performance impact usually fosters the resistance of physicians and can even result in the abandonment of a HIT implementation effort (Scott et al. 2005). During this evaluation process, individuals develop on the one side an intention to accept and on the other side an intention to resist the technology based on perceived qualities and threats related to the technology (Lapointe & Rivard, 2005). Acceptance behaviors reflect proactive intentions to use an IT and lead to the increased use of the IT and IT acceptance is the act of receiving IT use willingly (Saga & Zmud, 1994). Resistance is characterized by low levels of use, by a lack of use, or by dysfunctional, e.g., harmful use (Martinko et al., 1996). In addition, IT resistance was defined by IS research as an action or intentional inaction that opposes or sidesteps the implementation of new IT. It may manifest over time, from the program's inception through its deployment and operation and its intensity may wax and wane. A resister may be an individual, a group or an entire organization (Saga & Zmud, 1994).



User resistance in IS research has been conceptualized as an adverse reaction (Hirschheim & Newman, 1988) or the opposition of users to perceived change related to a new IS implementation (Markus, 1983). We reviewed the previous IS literature with the aim of uncovering existing theoretical understanding about user resistance. Lapointe and Rivard (2005) found four studies (Joshi, 2006; Marakas & Hornik, 1996; Markus, 1983; Martinko et al., 1996) that proposed theoretical explanations of user resistance. Among the theoretical explanations, Markus (1983) explains user resistance in terms of the interaction between system characteristics and the social context of its use. Markus (1983) explains resistance in terms of interaction between the system being implemented and the context of use and posits that a group of actors will be inclined to use a system if they believe it will support their position of power. If a user thinks it might cause him/her to lose power, he/she will resist. Joshi (2006) examines the issue of IS implementation and resistance to change from an equity theory perspective and develops an equity implementation model that attempts to explain resistance to change. Martinko et al. (1996) argued that the variables and dynamics associated with the rejection of IT can be conceptualized using an attributional perspective of achievement motivation. Therefore, their model draws on attribution theory and learned helplessness: a new technology, internal and external variables, and an individual's experience with success and failures at tasks involving similar technologies evoke causal attributes. Martinko et al. (1996) argued that the intensity and nature of resistance to IT depends on the interaction of these factors.

In contrast to Davis (1989) who motivated his study to explain user acceptance through users' unwillingness to accept and use available systems, Venkatesh and Brown's (2011) research broadens that acceptance perspective by presenting preliminary evidence

that non-adoption (rejection) decisions are based on different critical barriers. Most of the research on IS implementation deals with system user acceptance (Venkatesh, 2000; Venkatesh & Davis, 2000; Venkatesh & Morris, 2000; Venkatesh et al., 2003) where resistance is considered as the reverse side of the acceptance. There have been several models that have been employed to predict behavioral intention to use a system and, consequently, system use (Venkatesh et al., 2003; Venkatesh et al., 2007). While such models have helped us make substantial progress in understanding adoption and use, their focus has primarily been on the individual-level psychological processes and contingencies that manifest as technology related perceptions and situational factors respectively (Venkatesh et al., 2003; Venkatesh et al., 2007). Although social influences have been incorporated in prior models and have been proposed to be critical determinants in the early stages of use (Venkatesh et al., 2003; Venkatesh & Davis, 2000), such social influences have primarily been treated as external pressures exerted by peers and superiors such that they sway an individual's perceptions related to system use. Thus, prior research explaining system use has not fully taken into account the richness of social interactions that can ensue in the post-adoptive phase of a system implementation.

EHR requires learning a new system, and learning new technology is not a priority in the current work day of most hospitals. EHR changes the way hospitals do business and technology creates a new workflow system for physician and nurses. Currently, physicians and nurses do not see any issues with how hospitals are currently operating. EHRs are seen as contrary to a physician's and nurse's traditional working style, EHRs require a greater capability in dealing with computers (DesRoches et al., 2008). A certain level of computer

skills are required by physicians. Physicians aren't as technically advanced as one might imagine.

Most physicians consider EHRs to be challenging to use due to multiple screens, options, and navigational aids (Ludwick, 2009). The complexity and usability problem associated with EHRs results in physicians having to allocate time and effort if they are to master them (Boonstra, 2010). Physicians have to learn how to use the EHR system effectively and efficiently which they see as a burden. The lack of technical skills leads the physician to regard EHR system as extremely complicated. Physicians have a central role in the use of the EHRs, as they are who provide much of the information that the systems handle in their automated processes (Castillo, 2010). EHR systems require a fair amount of user knowledge and aptitude, which can cause hardship for those not trained in the technology (Feigenbaum, 2013). There is a learning curve for physicians as it relates to EHR. Physicians also need to spend time and effort, learning to use an EHR system. However, the demands and pressures of delivering office-based care may not afford them the time to learn the system (Simon, 2007). Technology is sometimes distract from the real problem. Human typically blame a new technology for the problems occurring in the organization. Argyris (1977) suggests there are “deeper” (p. 113) reasons behind the implementation gap of IS, especially when the technology was used to deal with the more complex and ill-structured problems faced by the organization. He implies that the MIS need to be viewed as a part of a more general problem of IL.

## **2.4 Hierarchy Nature of Health Care**

It is important to mention the unique characteristics of the health care to understand the challenges of information technology. Health care is a very distinctive in nature from other industries. Health care organizations have clearly defined lines of power, authority,

and flow of information. They remain as hierarchical organizations in regard to this power, authority and flow of information (Thede, 2011). Several striking features of the health care industry is the level of diversity that characterizes patients (e.g., physical traits, and medical history), professional disciplines (e.g., doctors, nurses, administrators, and insurers), treatment options, health care delivery processes, and interests of various stakeholder groups (patients, providers, payers, and regulators) (Fichman, Kohli & Krishnan, 2011). Most research on EHR adoption and resistance, still hold true to understand the challenges that hospitals will face to develop routinization. Hospitals have powerful actors such as physicians that often resist technology (Doolin, 2004).

Portion of this arises from professional norms: physicians are primarily concerned with treating the patient to the best of their ability and regard other activities as administrative irritants (Fichman, Kohli & Krishnan, 2011). Given the hierarchical nature of health care, technology abhorrence by an influential physician or nurse is likely to affect other caregivers (Fichman, Kohli & Krishnan, 2011). Walter (2008) suggests that physicians differ from other types of IT users investigated in the literature with respect to IT acceptance. The differences originate from their specialized training, autonomous practices, and professional work arrangements. Physicians are known for professional autonomy. Professional autonomy refers to professionals' having control over the conditions, processes, procedures, or content of their work according to their own collective and, individual judgment in the application of their profession's body of knowledge and expertise (Walter & Lopez, 2008). Physicians are not used to rules and regulations. Physicians are trusted to not only work conscientiously without supervision but also to self-regulate to undertake the proper regulatory action on those rare occasions

when an individual does not perform his work competently or ethically (Walter & Lopez, 2008). A case study of Canadian physicians found that most general practitioners welcomed clinical guidelines as a means of improving care, but they resisted them when they perceived that the guidelines encroached on their professional autonomy (Dowswell, Harrison & Wright, 2001). Hence, meaningful use has created the introduction of technology. Technology automatically introduce new constraints to professional autonomy. Physicians proclaim that they are in the best position to operate, control, and regulate their own practices.

## **2.5 IT Continuance**

Over the last 10 years, IS has seen a growing body of research on IT continuance, and more generally on IT post-adoptive behaviors (Ahuja & Thatcher, 2005; Bhattacharjee, 2001; Bhattacharjee & Premkumar, 2004; Jaspersen et al., 2005). The essential argument is that continuing IT use is fundamentally intentional behavior driven by conscious decisions to act (Bhattacharjee, 2001). Most IT continuance is seen as a series of decision continue using IT (Bhattacharjee, 2001). This study will argue that IT continuance is far more than decisions related to continue use. We will put forth a model that represent organization factors that lead to EHR continue use. Most IT continuance literature applies to the individual level. IS literature on continuing IT use emphasizes the role of habitual behavior that does not require conscious behavioral intention, it does so in a way that largely remains faithful to the theoretical tradition of planned behavior and reasoned action (Guinea et al., 2009).

IT continued use has been the subject of important theoretical developments and empirical advances under a variety of labels, such as IT usage (Agarwal & Karahanna, 2000; Bhattacharjee & Remkumar, 2004; Burton-Jones & Gallivan, 2007; Kim &

Malhotra, 2005b; Straub et al., 1995), IS continuance (Bhattacharjee, 2001; Cheung & Limayem, 2005; Kim et al., 2007; Limayem et al., 2007), and post-adoptive IT usage (Jaspersen et al., 2005). In recent years, researchers have started to advocate the need to understand the continued IS usage behavior (Bhattacharjee, 2001; Davis & Venkatesh, 2004; Limayem & Hirt, 2003). IS continuance behavior patterns revealed continued use of an IS. Continuance refers to a form of post-adoption behavior. However, we argue that researchers must go beyond emotional, habits and beliefs to explain IT continuance. Individual and organizational learning factors play an important role on whether a system use become long term. IS continuance has been investigated both at the organizational and individual level of analysis. Saga and Zmud (1994) associated the IS post-adoption at the organizational level with the final three phases of their six-stage IT implementation model. These phases include organizational efforts undertaken to induce organizations to commit to the use of IT (acceptance), alterations that occur within the work system such that they are no longer perceived as new (routinization), and the process of embedding the IT into the organization's work system (infusion) (Limayem, Hirt, & Cheung, 2007).

#### *IT Continuance at the Organizational Level*

Cooper and Zmud (1990) were the first authors to look at IT continuance at the organizational level. The authors argued that there is a six-stage framework for implementations: initiation, adoption, adaptation, acceptance, routinization, and infusion. Implementation is most commonly depicted as the last stage of the three-stage sequence: initiation, adoption, and implementation (Cooper & Zmud, 1990; Kwon & Zmud, 1987). Research in this area seemed die off in the late 1990s. Organizational behaviors occurring beyond the latter stage, recognizing both the importance of these behaviors to IT success and that these behaviors are comprised of a set of activities guiding the development,

enhancement, and organizational facilitation of IT use. Adaptation, the modification processes directed toward individuals/ organizations and/or IT applications such that better fit occur, reflects the changing state. Acceptance refers to efforts undertaken to induce organizational members to commit to the use of IT application. Routinization refers to the alterations that occur within work systems to account for IT applications such that these applications are no longer perceived as new or out of the ordinary. Finally, infusion occurs as IT applications become more deeply embedded within the organization's work systems. (Appendix B describe several early research papers on routinization).

The definitions Cooper and Zmud (1990) cited for acceptance, routinization and infusion, improve the current understanding of IT implementation behaviors, they remain somewhat broad or ambiguous to guide IS research in developing common methods that consistently measure these constructs across research studies. Moreover, to assist the framing of research questions and integration of research findings, acceptance, routinization and infusion should be tightly linked to the theoretical foundation which surrounds them.

### *Acceptance*

Of three implementation activities being examined, user acceptance has by far received the most attention from scholars interested in understanding IT implementation success. Generally, user acceptance has been incorporated as a dependent variable with user satisfaction and system use as substitute measures. The theory of reasoned action (TRA) (Fishbein & Ajzen, 1988) posits that individual behavior is driven by behavioral intentions where behavioral intentions are a function of an individual's attitude toward the behavior and subjective norms surrounding the performance of the behavior. Attitude toward the behavior is defined as the individual's positive or negative feelings about

performing a behavior (Ajzen, 1975). It is determined through an assessment of one's beliefs regarding the consequences arising from a behavior and an evaluation of the desirability of these consequences. Davis technology acceptance model adapts TRA in modeling user acceptance of IT. Davis (1989) draws on a distinction made in TRA between attitudes, beliefs, behavioral intentions, and actual behaviors.

The theory of planned behavior (TPB) posits that individual behavior is driven by behavioral intentions where behavioral intentions are a function of an individual's attitude toward the behavior, the subjective norms surrounding the performance of the behavior, and the individual's perception of the ease with which the behavior can be performed (behavioral control). Attitude toward the behavior is defined as the individual's positive or negative feelings about performing a behavior. It is determined through an assessment of one's beliefs regarding the consequences arising from a behavior and an evaluation of the desirability of these consequences. Although Ajzen (1975) has suggested that the link between behavior and behavioral control outlined in the model should be between behavior and actual behavioral control rather than perceived behavioral control, the difficulty of assessing actual control has led to the use of perceived control as a proxy.

UTAUT aims to explain user intentions to use an information system and subsequent usage behavior. The theory holds that four key constructs—performance expectancy, effort expectancy, social influence, and facilitating conditions—are direct determinants of usage intention and behavior (Venkatesh et al., 2003). Gender, age, experience, and voluntariness of use are posited to moderate the impact of the four key constructs on usage intention and behavior (Venkatesh et al., 2003). The theory was developed through a review and consolidation of the constructs of eight models that earlier



research had employed to explain IS usage behavior (theory of reasoned action, technology acceptance model, motivational model, theory of planned behavior, a combined theory of planned behavior/technology acceptance model, model of PC utilization, innovation diffusion theory, and social cognitive theory).

*Routinization*

Saga (1994) identifies routinization as the alterations that occur within work systems to account for IT application such that these applications are no longer perceived as new out-of-the ordinary. Zmud & Apple (1992) show that earliness of adoption and at the extent of a technology diffusion are both associated with greater routinization. The frequency of use and standardized use are positively associated with increased formalization of core work processes (Dean et al., 1992). Core work processes refer to the sequences of tasks within an organization’s work system which are otherwise central to its success. Core processes will typically become more formalized as written rules, regulations, and policies about these work processes. The routinization of a technology should be viewed as having both positive and negative consequences (Table I).

**Table I: Positive and Negative Consequences of Routinization of a Technology**

Consequences	Aspects
Positive	Increase use of technology Facilitation of the technology’s infusion within an organization’s work systems.
Negative	Technology use becomes entrenched. Very difficult to introduce either new technologies or improved work processes.

(Source: Saga & Zmud, 1994)

### *Infusion*

Saga (1994) described infusion as the process of embedding and IT application deeply and comprehensively within an individual's or organization's work system (Cooper & Zmud, 1990; Kwon, 1987; Sullivan, 1985). Zmud and Apple (1992) develop these ideas to further the argument that work system configurations represent discrete levels of use for a given technology being applied within a specific work system. All successful IT applications are enhanced or reconfigured, reflecting an increasing organizational understanding of both a work system and potential of IT to support the work system (Kling & Iacono, 1984). This conceptual model clearly show that IT moves through an evolution or multiple levels of use, little research has been directed at understanding either the nature of organizational levels or use.

This research focuses on organizational behavior beyond the latter stage, recognizing both the importance of these behavior to IT success and that these behaviors are comprised of set of activities guiding the development, enhancement, and organizational facilitation of IT use. Four processes are identified beyond the initial decision to adopt and install a new technology. Adaptation represents the change state of Lewin's (1952) change model. Acceptance, routinization, infusion mark the refreezing state of Lewin's (1952) change model. Lewin (Burnes, 2004) offered a three-stage model of change entitle unfreezing-change-refreeze model which focuses on prior learning being rejected and replaced through the change process. The first stage, unfreezing, focuses on the importance of past observational learning and cultural influences with regard to change (Weick & Quinn, 1999). Change requires adding new forces for change or removal of some

of the existing factors that are at play in perpetuating the behavior (Carter, 2008). The second stage, change, focuses on the process an individual goes through and encompasses the thoughts, feelings, and behavior involved in the process (Burnes, 2004). The final stage, refreezing, seeks to establish the new behavior until it becomes routine (Goodstein & Burke, 1991).

### *Individual Continuance*

Information technology (IT) continuance refers to sustained use of an IT by individual users over the long-term after their initial acceptance (Bhattacharjee, 2001). Most IT continuance is seen as a series of decision continue using IT (Bhattacharjee, 2001). This study will argue that IT continuance is far more than decisions related to continue use. I put forth a model that represent individual learning factors that lead to EHR continue use. IS literature on continuing IT use emphasizes the role of habitual behavior that does not require conscious behavioral intention, it does so in a way that largely remains faithful to the theoretical tradition of planned behavior and reasoned action (Guinea et al., 2009). However, this research study argue that researchers must go beyond emotional, habits and beliefs to explain the IT continuance.

Guinea and Marcus (2009) conducted a review of IT continuance. The authors concluded that there were three key pillars of IS knowledge about continuing IT use:

- At its most fundamental level, continuing IT use is driven by conscious intentions that result from a rational decision-making process involving beliefs, expectations, reflections on past experience, etc.
- Emotion, not just cognition, may be an input to the continuing use decision or intention formation.

- Over time, in stable contexts, continuing IT use becomes habitual, which means that well-learned action sequences may be activated by environmental cues and then repeated without conscious intention (Guinea & Marcus, 2009).

IT continue use has been the subject of important theoretical developments and empirical advances under a variety of labels, such as IT usage (Agarwal & Karahanna, 2000; Bhattacharjee & Remkumar, 2004; Burton-Jones & Gallivan, 2007; Kim & Malhotra, 2005b; Straub et al., 1995), IS continuance (Bhattacharjee, 2001; Cheung & Limayem, 2005; Kim et al., 2007; Limayem et al., 2007), and post-adoptive IT usage (Jaspersen et al. 2005). In recent years, researchers have started to advocate the need to understand the continued IS usage behavior (Bhattacharjee, 2001; Davis & Venkatesh, 2004; Limayem & Hirt, 2003). IS continuance behavior patterns revealed continued use of an IS. Continuance refers to a form of post-adoption behavior. Although the term post-adoption refers to a suite of behaviors that follow initial acceptance (Rogers, 1995), include continuance, routinization, infusion, adaptation, and assimilation, in the literature it is often used as a synonym for continuance (Karahanna et al., 1999). Appendix C includes a literature review of IT continuance literature at the individual level.

## **2.6 Introduction to Routines**

Edmondson and Moingeon (2008) concluded that the IL literature is notably fragmented, with multiple constructs and little cross-fertilization among scholars (Fiol & Lyles, 1985; Huber, 1991; Shrivastava, 1983). The author's research objective was to identify and test managerial actions that improve organizational effectiveness through individual employees. The distinction between descriptive and intervention research provides a second dimension, and the two-by-two matrix shown in Figure 4 depicts the

resulting categories of learning phenomena. The matrix depicts the connection between IL, OL and routines.

		PRIMARY UNIT OF ANALYSIS	
		<i>Organization</i>	<i>Individual</i>
RESEARCH GOAL	<i>Descriptive research</i>	<p><b>Residues</b></p> <p>(1) organizations as residues of past learning</p> <p>(e.g. Levitt and March, 1988)</p>	<p><b>Communities</b></p> <p>(2) organizations as collections of individuals who can learn and develop</p> <p>(e.g. Pedler et al., 1990)</p>
	<i>Intervention research</i>	<p><b>Participation</b></p> <p>(3) organizational improvement gained through intelligent activity of individual members</p> <p>(e.g. Hayes et al., 1988)</p>	<p><b>Accountability</b></p> <p>(4) organizational improvement gained through developing individuals' mental models</p> <p>(e.g. Senge, 1990; Argyris, 1993)</p>

**Figure 1: A typology of OL research (Edmondson & Moingeon, 1998)**

Descriptive research at the organization level of analysis includes approaches stemming from behavioral theories of the firm and from theories of social construction (Edmondson & Moingeon, 2008). IL encompasses phenomena such as how routines shape organizational behavior, how knowledge is acquired, and the role of interpretive processes in precluding rational adaptation (Edmondson & Moingeon, 2008). Several scholars focus on the role and stability of routines in organizations. Levitt and March (1988) distinguish

theories of OL from theories of rational choice, resource dependency and population ecology. Rather than treating learning as a way to combat inertial tendencies in organizations, these authors view OL as an alternative mechanism to account for existing organizational behavior, that is, a mechanism that explains how organizations evolve over time and thereby accounts for the status quo.

Levitt and March (1988) described processes such as imitation and trial-and-error experimentation that explain how organizations behave and evolve over time. In contrast to the normative approaches discussed below, learning is seen as a faulty mechanism. Because behavior in organizations is routine driven (Cyert & March, 1963; Nelson & Winter, 1982), the lessons of the past, embodied in current routines, dominate organizational life. Organizational routines, in which “action stems from a logic of appropriateness or legitimacy, more than from a logic of consequentiality or intention” (Levitt and March, 1988, p. 320), are thus over-learned, such that actors are more habit driven and imitative than rational. Learning, in this model, is essentially the accumulated residues of past inferences. Levitt and March (1988) embrace the organization as their primary unit of analysis and focus on the ecological nature of how organizations select and encode routines.

Decades later, researchers such as Felin & Foss (2006), started discussion on the importance of individual routines (microfoundation). Microfoundation refers to methodological individualism (Felin & Hesterly, 2007). Microfoundations research focus has been to unpack collective concepts to understand how individual-level factors impact organizations, how the interaction of individuals leads to emergent, collective, and organization-level outcomes and performance, and how relations between macro variables

are mediated by micro actions and interactions (e.g. Abell, Felin, & Foss, 2008). Unpacking routines and capabilities into individual routines will advance our understanding of what drives differences in the behavior (Felin, Foss, Heimeriks & Madsen, 2012). Nickerson and Zenger (2008) suggest that microfoundations are organizational phenomena that are explainable in terms of individual action and interaction and ultimately in terms of human cognition and affect. Barnard (1968) argued that the individual is always the basic strategic factor of an organization. Traditional research in management points to micro-level phenomena or mechanisms, such as individuals, processes, and structures, and/or their interactions, as important causes of the emergence, function and dynamics of routines and capabilities (e.g., Burgelman, 1994; Cohen and Bacdayan).

## **2.7 Organization Routines Overview**

Nelson and March (1982) brought routines to the center of analysis for organization and economic change. Their major contribution, *Evolutionary Theory of Economic Change*, put the concept of routines center-stage, drawing attention both to the role of routines in the economy and the role of the concept of routines in theory. Scholarly progress toward conceptual clarity has been slow (Cohen et al., 1996; Cohen & Bacdayan, 1994). There are multiple definitions of the routine concept (Becker, 2001, 2004). Moreover, routines are also important because of the more immediate roles they have in organizations (Becker & Knudsen, 2001).

Despite 30 years of research, many ambiguities and inconsistencies in the concept of routines still prevail. Explanations that rest on the concept are not as clear as they could be, and progress has been slow (Avery, 1996). There has been “little progress in reaching agreement on what routines are” (Cohen et al., 1996, p. 656; Cohen & Bacdayan, 1994, p. 556). A “unified academic vision of the notion of routine does not exist” (Reynaud, 1998,

p. 468) and the “current understanding of routines remains imprecise” (Jones & Craven, 2001, p. 269). Becker (2004) acknowledged that progression has taken place, however a number of definitions exist to explain the concept of routine.

Routines are crucial to all organizations. Hence it is important to understand both how they can be built and how they can be changed. Hospitals have ignored the importance of establishing routines, which has led to medical mistakes (Mackintosh, Humphrey, & Sandall, 2014). Routines are imperative for analyzing how the business world works, for understanding how knowledge is retained and transferred, for the development of business strategy, and for the creation of policies to encourage more beneficial business practices (Hodgson, 2004).

#### *Definitions of Organizational Routines*

The recent literature converges on defining routines as “repetitive, recognizable patterns of interdependent actions, carried out by multiple actors” (Feldman & Pentland, 2003, p. 95). The organizational routine refers to a coordinated, repetitive set of organizational activities is a crucial element of OL and knowledge management (Levin, 2002). Levitt and March (1988) and Miner (1990) suggest, routines are the building blocks of OL and knowledge management, then it is important to begin understanding more about what leads to better or worse outcomes for a routine. Organizational routine defines as a coordinated, repetitive set of organizational activities (Miner, 1991). Repeated activities is echoed in much of the literature on organizational routines (Cohen et al., 1996; Cyert & March, 1963; Feldman, 2000; Levitt & March, 1988; Miner, 1990; Nelson & Winter, 1982; Pentland & Rueter, 1994). The literature on organizational routines; however, has been afflicted with definitional ambiguities, like OL.



There are several different views of organization routines. However, I acknowledge that other views exist due to the lack of consensus for the definition. This study highlights the most widely used definitions:

- Organizational rules
- Behavior
- Generative System
- Routines as organizational dispositions or capacities

**Routines as organization rules.** Routines are usually seen as a source of organizational inertia, and their intentional recombination a source of organizational adaptation (Cyert & March, 1963; Nelson & Winter, 1982). The Carnegie School's organizational behavior perspective of routine was conceptualized as following a set of rule-based performance programs and standard operating procedures. Carnegie School has taken the routine as the basic unit of analysis. This point is perhaps most clearly articulated by Nelson and Winter (1982) in their development of evolutionary economics, but is implicit in an even larger body of research. March and Simon (1958) viewed performance programs as largely involving "highly complex and organized sets of responses" (p. 141) to environmental cues and suggested that programs are routinized to the degree that choice has been simplified by the development of a fixed response to defined stimuli. Rules in the business world are usually triggered by event or stimuli. There are many different rules, for example, heuristics or rule of thumb (Hall & Hitch, 1939; Katona, 1946), industry recipes (Spender, 1989), standard operating procedures (Cyert & March, 1963) and programs (Simon, 1965, 1967, 1977).

The generic term *routines* include the forms, rules, procedures, conventions, strategies, and technologies around which organizations are constructed and through which they operate (Levitt & March, 1998). Organizations learn from history and encoding inference derive routines that guide individual behavior. Most organizations hold on to the old way of things to create new routines. A technology change can spark discussion of new rules or procedures. However, there is always some aspect of the old rules brought forth.

**Routines as behavior.** Philosophical traditions have struggled with the relationship between mind and body (Descartes, 1641/1931), the organizations literature has struggled with an analogous tension between cognitive and behavioral perspectives on action. Nelson and Winter (1982) provide a basis for an evolutionary theory of economic change that explained long-run firm level behavior within a dynamic environment. In particular, in the context of OL, Fiol and Lyles (1985) make the important distinction between changes at a cognitive level in actors' understanding of causal relationships (i.e., the mind) and changes in the realm of actual behavior (i.e., the body) and they note that the two sorts of changes need not be related. Nelson and Winter (1982) originally connected routines with a set of rules. Later, the authors provided a revised definition to refer to routines as all regular and predictable behaviour patterns of a firm. This caused a shift between the conceptions of routines from being rule-like to behavioral. The modification identified an emphasis on the notion that tacit knowledge, which is integral in operating a routine, was more suitably defined as behavior rather than as organizational rules (Metcalf, 1998). The routine literature start to split, after Nelson & Winter (1982) distinction. The literature was divided into cognitive and behavior components. Cognitive literature, refers to the underlying rule-

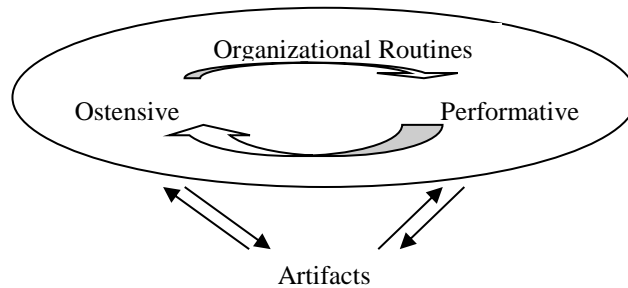
like structure in organizations, and the behavioral literature refers to behavior and to great extent the tacit knowledge involved in organizational capabilities (Hodgson, 2013).

Building on Nelson and Winter's work from the organization behavior and management literature, there is the view of organizational routines as recurring patterns of behavior of multiple organizational members involved in performing organizational task (Feldman & Rafaeli, 2002). This definition implies that organizational routines involve more than one person in more than one interaction. Each individual actor is connected, through his or her role in a routine to other employees who represent a certain part of the routine (Feldman & Rafaeli, 2002).

**Routines as generative systems.** The multiplicity of definitions has led some authors to combine the two dimensions, viewing routines as a generative system, rather than defining the routine on either level. Feldman and Pentland (2003) proposed such a framework (Figure 2).

**Routines as organizational dispositions or capacities.** These early insights on organizational behavior, Nelson and Winter (1982) provide a basis for an evolutionary theory of economic change that explained long-run firm level behavior within a dynamic environment. As a unit of analysis, Nelson and Winter transposed Cyert and March's concept of standard operating procedures (Cyert & Marsh, 1963) within an evolutionary context terming it as an organizational routine (Pierce, Boerner, & Teece, 2002); while giving the term a more technical meaning as a holder of organizational memory, of the tacit knowledge sort, and as a replicating unit of selection and recombination; likened to 'genes' in evolutionary biology. However, in contrast to defining routines as the 'rules' of the organization as largely described under the Carnegie School, Nelson and Winter defined

routines as “all regular and predictable behavior patterns of a firm” thus shifting the conception of routines from being rule-like to behavioral. The transition was meant to place greater emphasis on the idea that tacit knowledge, which is integral in operating a routine, was more suitably defined as behavior rather than as organizational rules.



**Figure 2: In Feldman and Pentland’s (2003) proposed framework, routines are viewed as generative systems with ostensive referring to the cognitive dimension and performative referring to the behavioral dimension.**

However, aligning routines with the definition of behavior has proven quite confusing for some authors (Becker, 2004; Cohen et. al., 1996; Feldman & Pentland, 2003; Hodgson, 2008; Hodgson & Knudsen, 2004), largely because some of the concepts Nelson and Winter illustrate seem to refer more to a general rule-like dimension or even a representational dimension of behavior rather than to behavior itself (i.e. actual performance).

The ostensive aspect is viewed as the routine in abstract, the cognitive regularities and expectations that enable “participant to guide, account for and refer to specific performances of a routine.” In addition, the ostensive aspect consists of the subjective interpretation of individuals. According to the authors, this makes it difficult to pinpoint *exactly* what the ostensive aspects are as a whole since it is a collection of partial and

overlapping subjective perspectives. The performative aspect consists of “actual performances by specific people, at specific times, in specific places” (Feldman & Pentland, 2003, p. 94). The two aspects are considered mutually constitutive and form the organizational routine.

These two aspects of the organizational routine may also be enabled or constrained by various artefacts. Artifacts are the physical manifestations of the routine. According to the authors, the artifacts serve as empirical representation or indicators of either the ostensive or performative aspects. Artifacts for the ostensive aspect maybe in the form of written rules and standard operating procedures (codified form) while artifacts for the performative aspect may consist of transaction histories or databases that track workflow.

In addition, Hodgson and Knudsen define organizational routines as an acquired *disposition* or *capacity* to express a particular behavior or thought (Hodgson, 2008; Hodgson & Knudsen, 2003a, 2003b, 2004; Hodgson, 2008; Knudsen, 2008). This view stems from the conception of habits in the old institutional economics tradition of Veblen and the Pragmatist Philosophy of Pierce and Dewey (Hodgson, 2008). According to the authors, dispositions are considered to be a subset of rules and therefore follow an ‘if-then’ structure. However, a distinguishing feature of the disposition’s perspective in relation to rules seen from the Carnegie School is that the rules are internalized or embodied more specifically in the procedural knowledge of the individual and embedded within an organizational routine. For example, it is not enough for a person to know the speed limits when on the Danish main roads in order to follow them, in order to be a disposition keeping the speed limits must be an automatic practice. It is only when rules are adopted and become a part of procedural knowledge are they considered to be a disposition. In addition,

the concept of dispositions put forth by Hodgson and Knudsen (2008) is distinguished from behavior. The view that procedural or tacit knowledge resides at the behavioral level (i.e. Nelson and Winter definition of routines as behavior). Hodgson and Knudsen (2008) consider the routines (as dispositions) distinct from the behavior it produces. Hodgson (2008) defines routines at the level of potentiality as an “organizational disposition to energize conditional patterns of behavior within an organized group of individuals involving sequential responses to cues” (p 33). According to Hodgson (2008),

*Routines cannot be both generative structures and outcomes of such structures. This point is not about the appropriateness or otherwise of biological analogies but about the clear meanings of words and their ontological references...it cannot usefully denote both potentiality and actuality. It has to denote one or the other, but not both. (p. 19)*

While no common definition of routine exists, the different conceptions of routines tend to focus on four different definitions. I would summarize routines as patterns, repetitive behaviors, coordinating mechanisms, and generative system. The first definition views routines from a motivational perspective as rules, structures, recipes, and techniques that channel behavior (Anderson, 1999). The second sees routines as repetitive behavior itself or as ‘interaction’ patterns (Becker, 2004). The third view focuses on the role of routines as coordinating mechanisms (Lam, 2000). According to this view, routines are defined as organizational dispositions or capacities to produce repetitive behavior through the sequential triggering of habits/skills. The fourth and final definition perceives routines as a ‘generative system’ consisting of both a cognitive and behavioral dimension (Pentland & Feldman, 2005).

*Characteristics of Routines*

The review of literature shows that routines have key characteristics. Most research utilized a key characteristic to build their own individual perspective of a routine. Figure 3 identifies the key characteristics of organization characteristics. In this section, I review several key characteristics that have persistently described routines in an organizational context:

- Routine as a pattern
- Routines are triggered, context specific, and automatic
- Routines are persistent
- Routines are path dependent
- Routines as a source of organizational memory: Knowledge in routines

**Table II: Key Characteristics of Organizational Routines**

1. Routines are recurrent, collective, interactive behavior patterns.
2. Routines are specific (they have a history, a local context, and a particular, set of relations), there is no such thing as universal best practice.
3. Routines coordinate (they work by enhancing interactions among participants).
4. Routines have two main purposes-cognitive and governance.
5. Routines conserve cognitive power for non-routine activities.
6. Routines store and pass on knowledge.
7. The knowledge for executing routines may be distributed or dispersed.
8. Routines reduce uncertainty, and hence reduce the complexity of individual decisions.
9. Routines confer stability while containing the seeds of change.
10. Routines change in a path dependent manner.

11. Routines are triggered by actor related factors and be external cues.

**Figure 3: Becker's (2004) 11 Key Characteristics of Routines.**

**Routine as a pattern.** Routine as a pattern has been a central theme from early researchers (Becker, 2004). In 1964, Winter defined a routine as a pattern of behavior that is followed repeatedly, subject to change if conditions change (p. 263). Financial crises or new ideas in the industry, for instance, cause routines to change. Technology is one explicit impetus that has been shown to bring about changes in the way an organization structures the accomplishment of work (Barley, 1986, 1990; Orlikowski, 1992). Koestler (1967) defined routines as “flexible patterns offering a variety of alternative choices” (p. 44). The notion of patterns have been conceptualized by a number of scholars (Cohen, 1996; Grant, 1996; Heiner, 1983; Nelson & Winter 1982). Routines consist of action, activity, behavior, and interaction (Becker, 2004). The economic and business literature have different views on these terms. In the economic and business literature, there is an agreement on action and activity and they are usually used as synonyms. However, behavior is distinguished from action because it is observable. Becker (2004) suggests that interaction is a subset of action and this refers to multiple actors. While noting that interaction creates a distinction between individual and group level.

Historically, the term routines clearly referred to recurrent interaction pattern that is collective recurrent activity patterns (Becker, 2004). Routine can also be understood as cognitive regularities or cognitive patterns (Cohen, 1991; Cyert & March, 1963; Delmestri, 1998; Egidi, 1992; March & Simon, 1958; Simon, 1977). Cognitive regularities and cognitive can be referred to as rules, and routines would be seen as a rule. Organizations hold many rules that are heuristics and rules of thumb (Hall & Hitch, 1939; Katona, 1946),



industry recipes (Spender, 1989) standard operating procedures (Cyert & March, 1963) and programs (Simon, 1965, 1967, 1977). Routines are important in organizations, in part because a lot of the work in organizations is performed through routines (Cyert & March, 1963; March & Simon, 1958). Researchers have considered routines as they related to organizational structure (Blau & Schoenherr, 1971; Jennergren, 1981), technology (Galbraith, 1973; Gerwin, 1981; Nelson & Winter, 1982; Stinchcombe, 1960; Thompson, 1967), innovation (Beyer & Trice, 1978; Hedberg et al., 1976), socialization (Beyer, 1981; Kanter, 1977; Kaufman, 1967; Sproull, 1981), and decision making (Allison & Zelikow, 1999; Cyert & March, 1963; Lindblom, 1959; March & Simon, 1958; Selznick, 1957; Steinbruner, 1974).

**Routines are triggered, context specific, and automatic.** Routines operate through the triggering of individual habits (Hodgson, 2004). The term habit refers to an individual behavior patterns (Dosi et al., 2000). Hodgson (2003) took the definition a step further to state “a habit is here defined as an individual-level disposition to behave or think in a particular way in a particular class of situations” (p. 357). Habits and routines pervade everyday life to an extent that it may be difficult, even upon reflection, to comprehend their presence and influence (Knudsen, 2007). A clear example of a habit is when a nurse first see a patient, they automatically weight the patient and take their blood pressure. Nelson and Winter (1982) used the phrase “remembering by doing” (p. 119) whereby the context triggers the appropriate habit or skill to call into play. Once an organizational member established a collection of habits involved in knowing their job, the habit called into action. Habits and routines contain encoded instructions for behavior or thought (Hodgson, 2008). But a trainee may have to inquire on how to carry on in an unfamiliar task or select a

course of action, an individual with the appropriate habits in place are simply able to enact them.

According to Hodgson (2008), routines are not solely reducible to individual actions; rather routines exist due to “structured interactions of individuals that give rise to emergent properties that (by definition) are not properties of individuals taken severely. Empirical evidence also supports the triggering as a mechanism for routinization. Furthermore, as noted by Nelson and Winter (1982) the habits formed and enacted by individuals in the performance of routine are only meaningful and effective in an organizational context which aid in structuring the enactment of habits. The same mechanism involved in the automatic interpretation and execution of an individual skill is also responsible for the automatic execution of multi-person routines, whereby the habit (or skill) enacted by one member, primes and triggers the skill of another (Cohen & Bacdayan, 1994; Egidi, 1996; Nelson & Winter, 1982). Cohen and Bacdayan (1994) validated that after a series of iterations in a mutually incentivized card game, the two players involved, shifted from intentional modes of behavior to automatic modes; whereby the initial action of one player triggered the response of the other, to the extent that coordinated patterns of action sequences emerged.

**Routines are persistent.** Another commonly recognized characteristic of routines is that once a routine is established within an organization they tend to persist. Empirical studies support the claim that organizational routines are fundamental sources of persistence in various organizational features (Knudsen, 2007). Psychological research further uncovers the underlying mechanisms (repetition-induced shifts in the control of behavior) that explain the persistence of habits and routines (Wood & Quinn, 2004). Habits

and routines are persistent, they multiply, and they contain ready-made solutions to frequently occurring problems (Knudsen, 2007). Historical research shows that habits and routines transplanted from England to North America during the great migrations around the beginning of the 17th century persist even into the present day (Fischer, 1989). Routines have traditionally been seen as a source of organizational inertia, and their intentional recombination a source of organizational adaptation (Cyert & March, 1963; Nelson & Winter, 1982). As Levitt and March (1988) noted, “routines are independent of the individual actors who execute them and are capable of surviving considerable turnover in individual actors” (p.320). Diffusion research shows, right from the first empirical studies, that it can take years, even decades before new habits and routines replace old ones (Attewell, 1992; Rogers, 1983). Routines are so persistent, they can at times provide solutions to problems that no longer exist.

Routines are persistent in the sense that they display considerable stability or invariance over time (Vromen, 2004). Routines in business organizations are often very persistent, even to an extent that they promote inertia (Baum & Amburgey, 2002; Benner & Tushman, 2002; Hannan & Freeman, 1989). Habits and routines are persistent packages of encoded instructions for behavior or thought. Once this data is passed on to a new copy, habits and routines function as replicators if they are causally involved in producing a new copy that is similar to the old in all relevant respects (Aunger, 2002; Godfrey-Smith, 2000; Sperber, 2000). Medical research shows that both unhealthy and healthy habits are persistent (Macready, 1999). Habits are conveyed through education, involving instruction, feedback and examples (Knudsen, 2007). Hence, organization training could potentially focus on building positive habits. For example, routines further propagate indirectly as a

consequence of adopting new technologies, such as automated dishwashers and Internet connections in private homes (Knudsen, 2007).

**Routines are path dependent.** The characteristic of routines as being both stable and persistent also effect the development and course of new routines in a path dependent manner (Becker, 2004). Path dependence refers to a mean more than the mere existence of timeworn routines, cognitive rigidities, or structural inertia (Sydow et al., 2009). Some researchers have argued that routines originate from random, quasi-random, or path-dependent search related to past problems and associated solutions (Becker, 2004; Cohen, March, & Olsen, 1972) or, more simply, past history (Levitt & March, 1988). Path dependent development of routines means that because one can get stuck on a path, along which the routine develops over time, keeping in mind the starting point matters (Becker, 2004). However, competency trap could potentially have a negative effect on path dependence. Organization may perform poorly and even fail by doing well what it learned in the past; it may suffer the so-called competency trap (Levitt & March, 1988). The competency trap notion suggests that organizations may reduce their exploratory activity prematurely and, in the case of a changing environment, not renew exploratory search and learning activities despite the fact that new opportunities and threats are present (Baum, 1998).

In organizations initial choices and actions are embedded in routines and practices; they reflect the heritage, the rules and the culture, making up those institutions (Child, 1997; March, 1991; Tolbert & Zucker, 1996). According to Levitt & March (1988) the decisions made in the past affect the decisions made in the future. Betsch (2001) conducted experiments involving repeated decision making with increasing availability of information

show that path dependence manifests itself because actors take prior experience into account when making decisions. So prior experience plays a focal role in determining path dependence. Managers and organizations make fateful decisions or choices related to paths that they might pursue or activities which may later become routinized (Felin & Foss, 2009). Firms that build their strategies on path dependent, causally ambiguous, socially complex, and intangible assets outperform firms that build their strategies only on tangible assets (Barney, 1991).

**Routines as a source of organizational memory: Knowledge in routines.** One of the most noteworthy characteristic of organizational routines is its ability to store organizational knowledge. The outcomes of OL result in the formation of routines that provide standard ways of conducting organizational activities under learned circumstances (Levitt & March, 1988.) According to Nelson and Winter (1982), routines are the “locus of operational knowledge in an organization” (p. 104). After such circumstances arise in the future, routines are triggered. As such routines provide the organization with a source of organizational memory (Levitt & March, 1988). Routines consist of two interconnected aspects that allow them to be considered as such. On the one hand, routines are standardized organizational techniques described as ‘recipes,’ ‘technologies (Nelson & Sampat, 2001)’ or ‘standard operating procedures (Cyert & March, 1963),’ that, in conjunction with the broader social or institutional context, provide a structure that sharply channel behavior. According to Nelson (2008) the terms *technologies*, *standard operating procedures*, and *recipes* are “steps involved in a productive technique *without* specifying *how* techniques are to be assigned to individuals and *how* coordination is accomplished by these individuals” (p. 11).

Routines hold a fundamental relationship between structure and action (Pentland & Reuter, 1994). The knowledge held in the former is largely articulable, explicit, and in many cases may be codified into descriptive and formalized procedures, while in the later the knowledge held in the organization is largely tacit, inarticulate, and automatically executed (Nelson, 2008). Routines are an example of firm resources and capabilities (Barney, 2001). Routines are ‘organizational capabilities’ composed of individual habits or skills involved in an interlocking and reciprocally triggered sequence of events that provide the level of interpretation, coordination, and codes for action involved in a productive organizational performance (Cohen & Bacdayan, 1994; Hodgson, 2008; Nelson & Winter, 1982).

**Change of routines through dynamic capabilities.** Pioneering efforts such as Selznick’s (1957) “distinctive competence,” to the more recent and refined notions of organizational routines (Nelson & Winter, 1982), absorptive capacity (Cohen & Levinthal, 2000), architectural knowledge (Henderson & Clark, 1990), combinative capabilities (Kogutand & Zander, 1992) and, finally, dynamic capabilities (Teece et al., 1997). The most recent literature on routine change derives from the literature on dynamic capabilities (Eisenhardt & Marting, 2000; Teece & Pisano, 1997; Winter, 2003). Intentionally or not, individuals and groups depart from the standard practices routines are said to specify (Adler et al., 1999; Dougherty, 1992; Feldman, 2000; Leidner, 1993; Narduzzo et al., 2000; Victor et al., 2000). When this situation happens in the workplace, the same routine allows a diversity of actual performances and some of these performances may, in turn, alter the routine over time. New technologies and an increasingly global economy have resulted in an era of rapid change and a demand for high quality performance under variable

circumstances (Feldman & Rafaeli, 2002). An organizational capability is a high-level collection of routines (Winter, 2003). Nelson and Winter (1982) were among the first to view an organization as a set of interdependent operational and administrative routines which slowly evolve on the basis of performance feedbacks. There have been a number of definitions put forth for dynamic capabilities. Below are two such definitions from the literature:

- Teece et al. (1997) define the concept of “dynamic capabilities” as “the firm’s ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments” (p. 516).
- A dynamic capability is a learned and stable pattern of collective activity through which the organization systematically generates and modifies its operating routines in pursuit of improved effectiveness (Zollo & Winters, 2002).

Drawing on these definitions, the most crucial point is that organizations must integrate, build, and reconfigure their competencies. Capabilities are subjected to rates of change; even more complexity involves capabilities that are comprised of multiple levels. Cohen (1996) theorized that hierarchical nature of routines refers to nested hierarchy of even smaller routines; whereby learning takes place at several nested levels (Cohen et al., 1996). It is important to understand how hierarchical nature contributes to dynamic routines. March & Simon (1958) suggests that a change in routines can occur due to problem occurrences at lower level programs (routines) that initiate a response in higher level programs “whose goal is to revise other programs, either by constructing new ones, reconstructing existing ones, or simply modifying individual premises in existing programs” (March & Simon, 1958. p. 149).

## 2.8 Individual Routines

Routines has become a central construct in the field of management. Routine research has played a prominent role in the analysis of organization. Routines are closely linked to knowledge in the field of management. A lot of progress has been made in the area of routines. The underlying foundation or microfoundation of routines has received little attention. This study draws a connection between organization routine and individual routines to understand why individual routines are important to hospitals. The term microfoundation has be used to describe individual routines.

The concept of microfoundations is traditionally linked with the notions of “reduction” or “decomposition” in science and with “methodological individualism” in the philosophy of social science (Felin & Foss, 2012, p. 3). The notion of microfoundations is also informed by a long tradition of debate in philosophy and sociology regarding whether individuals or collectives should have explanatory primacy in social theory (e.g., Coleman, 1964; Lazarsfeld and Menzel, 1970; Popper, 1957; for an overview, see Udehn, 2001). Felin (2006) identified three primary categories of micro-level components underlying routines and capabilities: individuals, social processes, and structure and design.

A microfoundations approach identifies a set of collective phenomena in need of explanation, specifically the origins, creation and development, reproduction, and management of collective constructs such as routines and capabilities (Felin & Foss, 2006). Microfoundation involves lower-level entities, such as individuals or processes in organizations, and their interactions. Researchers have argued that a strong motivation for unpacking routines and capabilities in microfoundational terms is that doing so will advance our understanding of what drives differences in the behavior (Felin, Foss, Heimeriks & Madsen, 2012). Barnard (1968) argued that “the individual is always the



basic strategic factor of organization (p.139).” Traditional research in management points to micro-level phenomena or mechanisms, such as individuals, processes, and structures, and/or their interactions, as important causes of the emergence, function and dynamics of routines and capabilities (e.g., Burgelman, 1994; Cohen and Bacdayan, 1994; Cyert and March, 1963; Hoopes and Madsen, 2008; Knott, 2003; March and Simon, 1958; Murmann, 2003; Narduzzo et al., 2000; Pentland and Reuter, 1994, Selznick, 1984; Zbaracki and Bergen, 2010).

The microfoundations of organizational routines and capabilities include two sources: 1) constituent components (i.e., main effects) - individuals, processes, and structure and design; and 2) interactions within and across components – the interactions of individuals, processes, and/or structures and design that contribute to the aggregation and emergence of the collective constructs. Teece (2007) were the first researchers to conceptualize individual routines. Table 1 provides a summary of some of the exemplary contributions in top journals, articles that are explicitly microfoundational. Individual routines research is based on the following statements:

- i. Organizations are made up of individuals, and there is no organization without individuals (Felin and Foss 2005, p. 441).
- ii. Specifically, there are no conceivable causal mechanisms in the social world that operate solely on the macro-level (Abell, Felin and Foss 2008, p. 491).
- iii. We take the position associated with methodological individualism that the explanation of firm level (macro) phenomena in strategic management must ultimately be grounded in explanatory mechanisms that involve individual action and interaction (Abell, Felin and Foss 2008, p. 492).

- iv. Combining methodological individualism with an emphasis on causal mechanisms implies that strategic management should fundamentally be concerned about how intentional human action and interaction causally produce strategic phenomena (Abell, Felin and Foss 2008, p. 492).

**Table III: Significant Microfoundational Work 2003 -2014 (adapted from Felin, Foss & Playhart, 2015)**

Authors	Understanding of Microfoundations	Dependent Variable	Independent Variable	Method
Lippman and Rumelt (2003a)	Microfoundations of a subject are definitions of its basic elements and the allowable operations that can be performed using these elements” (p. 903)	Rent	Strategies that increase resource scarcity	Conceptual and theoretical
Lippman and Rumelt (2003b)	Bargaining outcomes understood in terms of the bargaining behaviors of individual resources owners	Resource-level value appropriation	Bargaining strengths of individual resources owners	Conceptual and theoretical
Felin and Hesterly (2007)	Methodological individualism	Firm-level knowledge (e.g. capabilities)	Individual-level heterogeneity	Conceptual and theoretical
Gottschalg and Zollo (2007)	Individual motivation is crucial to understanding organizational outcome	Value and rent-creation at the individual level	Different kinds of motivation	Conceptual and theoretical

Authors	Understanding of Microfoundations	Dependent Variable	Independent Variable	Method
Teece (2007)	“the distinct skills, processes, procedures, organizational structures, decision rules, and disciplines-which undergird enterprise-level sensing, seizing and reconfiguring capacities” (p. 1319)	Dynamic capabilities	Routines for sensing and seizing opportunities in the environment and reconfiguring assets	Conceptual and theoretical
Nickerson and Zenger (2008)	Organizational phenomena are explainable in terms of individual action and interaction and ultimately in terms of human cognition and affect	Organizational structure	Individual emotions	Conceptual and theoretical
Aime, Johnson, and Ridge (2010)	Not explicitly defined	Competitive advantage	Employee mobility	Analysis of panel data set
Eisenhardt et al., (2010)	“The underlying individual-level and group-level action that shape strategy, organization, and more broadly, dynamic capabilities” (p. 1263)	Dynamic capabilities/ firm performance	Leadership actions aimed at balancing efficiency and innovation	Conceptual and theoretical

Authors	Understanding of Microfoundations	Dependent Variable	Independent Variable	Method
Harrison, Bosse, and Philips (2010)	Not explicitly defined	Firm-level value creation	Organizational justice which allows more fine-grained managerial access to employee utility functions	Conceptual and theoretical
Lewin et al. (2011)	Routines and practices, such as open office plans, brainstorming sessions, and cross-functional project teams	Absorptive capacity capabilities	Meta-routines	Conceptual and theoretical
Lindenberg and Foss (2011)	Methodological individualism	Joint production motivation	Intertwined cognition and motivation that is influenced by organizational antecedents	Conceptual and theoretical
Argote and Ren (2012)	Not explicitly defined	Dynamic capabilities	Transactive memory systems	Conceptual and theoretical
Bapuji et al. (2012)	Not explicitly defined	Routine	Intermediaries bridge actions and ease routine formation	Field experiment of a towel-changing routine in a hotel
Miller et al. (2014)	Not explicitly defined	The formation, efficiency, and adaptability of organizational routines	Procedural, declarative, and transactive memory	Agent-based simulation

Authors	Understanding of Microfoundations	Dependent Variable	Independent Variable	Method
Mollick (2012)	“the part that individual firm members play in explaining the variance in performance among firms” (p.1001)	Heterogeneity in firm performance	Relative contribution to firm performance of middle-managers vs inventors	Multi-level empirics
Makela et al. (2012)	Individual action is the foundation of organization phenomena	Organization-level strategic HRM capabilities	The experience of subsidiary HR manager; and the social capital between managers working with HR issues in the subsidiary and those in the corporate HR function	Analysis of survey data from Nordic MNCs
Paruchuri and Eisenman (2012)	Not explicitly defined	How R&D capabilities change following a merger	Inventor networks	Case studies
Pentland, Feldman, Becker, and Liu (2012)	Not explicitly defined	Routine change	Higher level routines	Simulation
Baer et al. (2013)	Not explicitly defined	The formulation of strategic problems	Heterogeneous information sets, objective and cognitive structures	Conceptual and theoretical
Bridoux and Stoelhorst (2013)	Not explicitly defined	Attracting, retaining and motivating stakeholders to create value	Stakeholders with different motives who require different types of stakeholder	Conceptual and theoretical

Authors	Understanding of Microfoundations	Dependent Variable	Independent Variable	Method
Grigoriou and Rothaermel (2014)	Organizational phenomena can be reduced to individual action and interaction; however, the “embeddedness” of individual action must be considered	Knowledge-based organizational advantage (innovation)	Individuals in knowledge networks who are very high in centrality and bridging behaviors	Network analysis
Helfat and Peteraf (2014)	How the cognition of individual managers translates into actions that influence organizational outcomes.	Dynamic capabilities	Managerial cognitive capability	Conceptual and theoretical
Miller et al. (2014)	Not explicitly defined	Routines	Transactive memory	Theoretical and empirical
Morri et al. (2014)	Not explicitly defined	Transnational capabilities	Diverse knowledge form individuals	Theoretical and empirical
Rogan and Mors (2014)	Organizational phenomena can be reduced to individual action and interaction	Ambidexterity at the level of individuals. Org level implications discussed; However, no explicit aggregation is undertaken in the paper	Characteristics of network and ties	Network analysis of the internal and external ties of 79 senior managers

The naive way of thinking about an organization is as an aggregation of the individuals that compose them (Felin et al., 2012). Individuals cannot be ignored in the discussion of routines. Individual components such as choices, characteristic and cognition serve as building blocks for understanding routines. Research acknowledges that individuals make choices or decisions (Simon, 1969; 1987). Also, individuals bring different skills, knowledge, and experience to an organization. Turner (2012) illustrates how individual's experiences influence routines performance. The research study showed that an individual experience is a source of stability and variability in routine performance. The implementation of new technologies critically hinges on the learning processes as Edmondson, Bohmer and Pisano (2001) illustrated in their study of 16 hospitals. Other research stresses the role of "situated learning," suggesting that problem-solving hinges on individual interactions with technology in context (Tyre & Von Hippel, 1997). Hence, more insight has been generated over the past years into the role technology and ecology play in shaping routines and capabilities, this area remains important.

## **2.9 Link between Individual and Organization Routine**

"The individual is always the basic strategic factor of organization" (Banard, 1938, p. 139). Organizations are populated by individuals with various predispositions, experiences, characteristics, talents, abilities, preferences, expectations, etc. and the interactional patterns and collective outcomes of these individuals needs to be addressed (Felin & Foss, 2009). A fundamental problem with extant work on organizational routines and related/derived concepts is the lack of clear understanding of the origin of routines. Winter has explicitly noted that "the question of where routines and capabilities come from" (Winter in Murmann et al., 2003, p. 29). Routine is defined as "pattern of behavior

that is followed repeatedly but is subject to change if conditions change” (Simon, 1964, p. 263), and performance differences indeed are imputed to this routine, then a natural question is where this “patterned behavior” comes from in the first place. Organizational action, behavior, and outcomes are really proxies for interacting individuals who take action, behave, and create the overall, emergent outcomes (Felin & Foss, 2009). Felin (2006) suggest that the microfoundations of routines and capabilities can be clustered into three core or overarching categories: (1) individuals, (2) processes and interactions, and (3) structure and design. The categories are embedded in a sequential hierarchy. Research suggest that each category may have main effects on routines and capabilities and each category does not operate in a vacuum (Felin & Foss, 2006). The categories are entwined in different interactions within an organization (individuals and individuals; individuals and processes; etc.). This research suggests that interactions within and among categories can create a second set of effects that contribute to the collective phenomena of routines and capabilities (Felin, Foss & Heimeriks, 2012).

Micro-level phenomena, specifically, individuals, processes, and (organizational) structures, played a central role in the origins of management theory. Barnard (1968: 139) argued that “the individual is always the basic strategic factor of organization.” Early work on the behavioral theory of the firm (Cyert and March 1992; March and Simon, 1958) explored several microfoundational explanations of organizational heterogeneity (for a historical overview, see Felin and Foss, 2009). In the management literature, a large body of contemporary work indeed points to micro-level phenomena or mechanisms, such as individuals, processes, and structures, and/or their interactions, as important causes of the emergence, function and dynamics of routines and capabilities (e.g., Burgelman, 1994;



Cohen and Bacdayan, 1994; Cyert and March, 1992; Hoopes and Madsen, 2008; Knott, 2003; March and Simon, 1958; Murmann, 2003; Narduzzo et al., 2000; Pentland and Reuter, 1994, Selznick, 1984; Zbaracki and Bergen, 2010). Cultivating on this work, several recent theoretical and empirical studies devote explicit attention to the micro-level origins of routines and capabilities (Becker and Lazaric, 2003; Becker et al., 2005; D'Addiero, 2009; Gavetti, 2005; Helfat and Peteraf, 2010; Salvato, 2009; Rerup and Feldman, 2011; Feldman and Pentland, 2003, Pentland and Feldman 2008; Teece, 2007).

## **2.10 Routinization**

Routinization refers to automaticity in behavior. Features of automaticity include unintentionality, uncontrollability, lack of awareness, and efficiency (Bargh, 1994). Routinization develops through repeated execution of a behavior (Betsch, Haberich, Glockner, Haar, & Fiedler, 2001; Ouellette & Wood, 1998; Weiss & Ilgen, 1985) or, specifically in case of a skill, through practice (Anderson, 2000; VanLehn, 1996). During the skill acquisition process, performance becomes faster (Wickens & Hollands, 2000), mental resources are freed, the attentional load on the person is reduced (Kanfer & Ackerman, 1989), and performance requires progressively less conscious processing (Norman & Bobrow, 1975). Traditionally, routinization is treated as a feature of an employee's job or of the technology of an organization (Perrow, 1970; Price & Mueller, 1981) and is seen as the opposite of complexity (Baba & Jamal, 1991).

### **Routinization in IS**

This proposed study will carry forth and build on Zmud and Saga's (1994) concept of routinization. Routinization refers to the notion that truly successful technological innovations are no longer perceived as being new or out-of-the-ordinary and becomes

institutionalized (Ritti & Silver, 1986; Zucker, 1977) as the organization norm. Routine refers to the notion that procedures, habits or customs are regular part of daily life (Websters, 2004). Organizational routinization of an innovation is described by Yin (1979) as the achievement of variety of organizational passage and termed administrative infrastructure to account for the presence of the innovation. Yin (1979) found that routinization of innovation was dependent on its functional flexibility which means its ability to be broadly interpreted and applied by a user. Routinization occurs if the organization see visible benefits and widespread user acceptance. Routinization increases with leadership and management support.

A causal model was put forth by Zmud and Saga (1994) to explain organizational routinization. The construct of routinization was described by three variables: use perceived as being normal, standard use and administrative infrastructure development. The authors also linked user acceptance and two other variables: frequency of use and management intervention. Zmud and Apple (1992) show that early adoption provides more opportunities to use a technology, alleviate facilitating learning about the technology, and provides more time to adjust the administrative infrastructure. Zmud and Saga (1994) acknowledge the routinization have both positive and negative consequences. The positive points are that there is increased use of technology and technology becomes about of the daily work routine. The negative points arise from that fact technology becomes entrenched in the culture, it becomes very hard to introduce either new technologies or work processes.

Routinization refers to the notion that truly successful technological innovations are no longer perceived as being new or out-of-the-ordinary and becomes institutionalized as the organizational norm (Ritti & Silver, 1986; Zucker, 1977). Most IS literature

associates routinization with post adoptive behaviors. The complexity and malleability of today's organizational IS allow individual users to use these systems at different levels of sophistication, regardless of whether the system has been mandated for use (Moore, 1991). Even if the individuals may be mandated to use an installed system, their post-adoptive usage behaviors are largely voluntary as the individual decides the extent of this usage as well as the effort invested in learning about the installed IS and its relationships to business processes and the individual's role regarding these processes (Hsieh & Zmud, 2006). Research shows health-care professionals are using non-standard ways to use or circumvent the EHR to complete their work (Flanagan, Saleem, Millitello, Russ, & Doebbeling, 2013). An analysis of workarounds provides insight into how physicians adapt to limiting EHR systems use. Although workarounds may seem necessary to physicians and are not always problematic, they can pose a threat to patient safety (Koppel, 2008). Medical errors account for more deaths than breast cancer, AIDs, and motorcycle accidents (Ulrich et al., 2008).

Beyond routinization, Saga and Zmud (1994) argue that it is through direct experience with an IS and associated learning processes that individuals gain the capability to use an IS to its full potential, i.e., the infusion stage. Therefore, this study draws from OL as a theoretical lens. There is an intuitive connection between OL and IS (Sambamurthy et al., 2003). OL occurs due to the interplay of various factors such as structure, strategy, environment, technology, and culture. IS can facilitate this learning process by supporting the processes of knowledge acquisition, information distribution, information interpretation, and organizational memory (Huber, 1991). Researchers such as Dodgson (1993) and Brown and Duguid (1991) merely make a passing mention of the influence of

technology on learning. When an organization chose to adopt a new kind of IT, for example, it has been described as a learning process (Attewell, 1992). Organizations learn to improve their adaptability and efficiency during times of change (Dodgson, 1993).

#### *Routinization of EHRs*

Routines are regular and repetitive action patterns performed by multiple actors across time and space (Feldman and Pentland, 2003). In health care, routines are at the core of daily operations in hospitals and play a pivotal role in determining efficiency and quality of care (Greenhalgh, 2008). Shapiro and Varian (1999) suggested routinization reduces systems level uncertainty associated with competition and technological risk. Becker (2004) reviewed the literature on routinization and summarized its benefits into six categories: coordinating, controlling, economizing cognitive resources, reducing ambiguity, furnishing stability, and storing knowledge. Indeed, in spite of the high level of skill and expertise that is required for successful care delivery, the practice of health care is highly routinized and might prove to be even more so with the emergence of care protocols that detail the specific actions that caregivers must take (McAlearney, 2006). Routines are frequently recognized as a key organizational capability (Winter, 2003) and have been shown to influence performance outcomes (Cohen & Bacdayan, 1994; Gittel, 2002). In hospital settings, clinical routines specify the regular pattern of activities that caregivers must engage in as they administer patient care (e.g., rounding, patient information transfer) (Wright et al., 1998). Indeed, routines are of particular importance in high reliability settings like hospitals because there is little room for error (Tucker et al., 2007; Weick & Sutcliffe, 2006). As such, hospital routines ensure that quality is met through the consistent refinement of standard operating procedures. Without routines, risk, uncertainty, or pervasive uncertainty can plague a hospital. The role of routinization is to

limit the possible set of options that are considered and thereby enable better decisions (Becker & Knudsen, 2005). Routines will assist physicians, clinicians, and staff to cope with pervasive uncertainty under the constraint of bounded rationality because they can be used to save on mental efforts and thus preserve limited capacity required to deal with nonroutine events (March & Simon, 1958).

I have reviewed the literature on routines and routinization from various perspectives. For this study, EHR routinization refers to the regular and standard use of EHR systems by health care professionals, whereby the EHR system is no longer perceived as being new or out-of-the-ordinary (Saga and Zmud, 1992). Why would routinization be beneficial to a hospital? In Ohio, a number of hospitals have faced the complicated decision to terminate long standing relationships with physician practices. For example, the Summa Health in Akron fired all emergency room (ER) doctors and brought in new physicians as direct hospital employees. As such, 65 Summa Health ER doctors were replaced with doctors from US Acute Care Solutions after contract talks broke down. The abrupt change comes after failed contract negotiations with a private group of physicians who have worked for decades in Summa's ERs (Garrett, 2016).

What took place at Summa Akron is a very recent and relevant example. Nurses reported to the media that the replacement, contracted physicians, had been reported for giving deadly dosages of medication and reading tests and charts incorrectly. More importantly, it was reported that these physicians were using out-of-date medical practices and not trained on EHR. Based on the reporting, how many accidental deaths are occurring in this example? Routinization would assist in the transition because documented routines would be available for physicians. Routines are independent of the individual employees

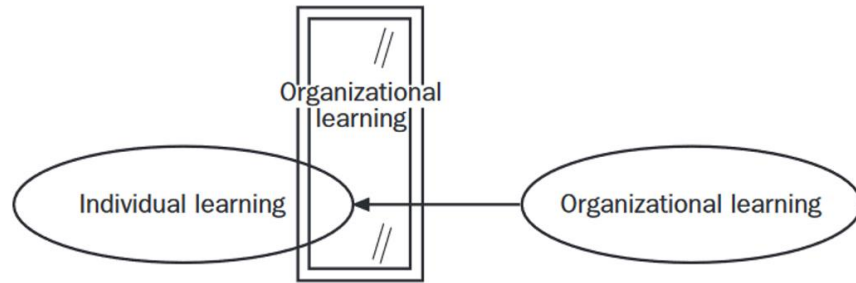
or contractors who execute them and are capable of surviving considerable turnover (Levitt & March 1988).

Several studies have demonstrated that the introduction of new medical technology can trigger the disruption of routines in health care settings (Barley, 1986; Edmondson et al., 2001). Barley (1986, 1990) examined how organizational structures changed with the introduction of CT scanners and radiology imaging devices. Edmondson et al. (2000) investigated how a new cardiac surgery technology disrupted existing routines and how team learning occurred. Health care requires an important level of skill and expertise that is required for successful care delivery, the practice of health care is highly routinized and might prove to be even more so with the emergence of care protocols that detail the specific actions that caregivers must take (McAlearney, 2006). Goh (2011) was one of the first research papers to address health care technology routinization in information systems literature. The study conducted an extensive longitudinal field study to gain an understanding of the interplay between technology and patterns of clinical work embodied in routines. Goh et al. (2011) focus on implementation of a new clinical documentation system to develop a model of to achieve effective routinization of new IT. Goh (2010) identified routines in health care as a black box because processes of care delivery are exceedingly complex and involve significant coordination, interdependence, and interactions among care providers (Gawande, 2002; Tucker et al., 2007). This study will continue to build on the literature by looking at what individual learning factors influence EHR routinization. In health care, routines are at the core of daily operations in hospitals and play a pivotal role in determining efficiency. In hospital settings, clinical routines specify the regular pattern of activities that caregivers must engage in as they administer

patient care (e.g., rounding, patient information transfer) (Wright et al., 1998). Despite the ubiquity of routines in care delivery processes and the centrality of routines to the fundamental work in hospitals, there is a surprising paucity of rich, in-depth studies of health-care routines in the literature (Goh, Gao, & Agarwal, 2011; Greenhalgh, 2008).

### **2.11 Link between Individual and Organization Learning**

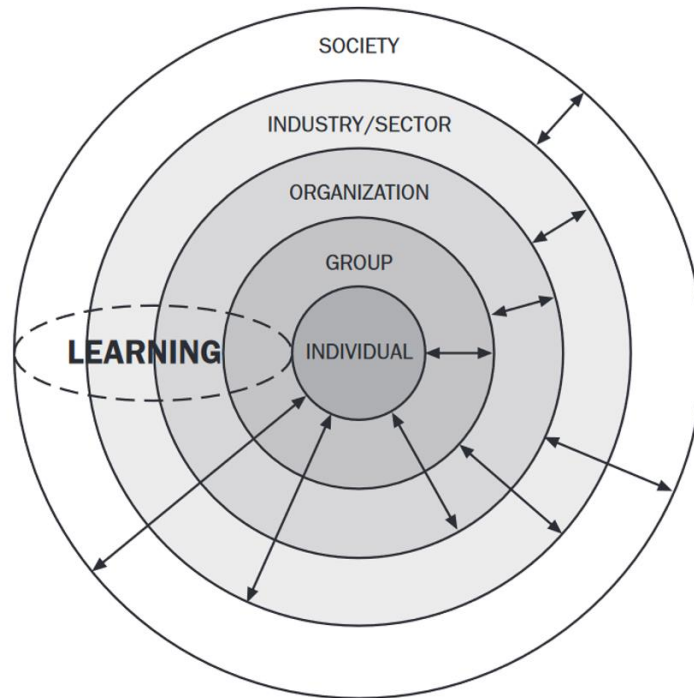
The relationship between individual and organizational learning remains one of the unresolved issues in current organizational learning debates. Several contributions have sensitized us to the interdependencies, differences, possibilities and challenges involved in aligning individual and organizational learning agendas (Antonacopoulou, 1998; Friedlander, 1983; Friedman, 2001; Kim, 1993; Richter, 1998). Commonly agreed that organizational learning is the product of individuals' learning (Argyris and Schon, 1996; Fiol and Lyles, 1985; Senge, 2006). However, recent thinking based on the same proposition, has shifted the focus on the collective practices of people within organizations, thus locating learning at the community group level taking into account the subcultures and related actions within the specific community structure (Brown and Duguid, 1991; Crossan et al., 1990; Lave and Wenger, 1991). Figure below shows the relationship between individual and organization learning. Organizational context in which learning takes place is seen to have the most significant influence on the meanings ascribed by individuals to learning, how they go about learning and what they seek to learn.



**Figure 3 Source: Antonacopoulou, E. P. (2006). The Impact of Organizational Learning on Individual Learning and The Reflection of Organizational Learning in Individual Learning.**

There are several notable arguments: i) organizations exhibit some learning abilities such as: competence acquisition, experimentation, boundary spanning and continuous improvement (DeGeus, 1997; DiBella and Nevis, 1998; Rheem, 1995), ii) organizations develop and accumulate knowledge in files, rules, roles, routines, procedures and through their culture and structure they develop shared mental models, values and behaviors, which constitute part of the organizational memory (Cohen and Bacdayan, 1994; Schulze, 2000; Walsh and Ungson, 1991; Weick and Roberts, 1993), iii) social process, which is affected by the contextual factors such as the organization structure, information, communication and control processes, which impact on the way individuals learn (Hedberg, 1981; Pawlowski, 2001; Simon, 1987). The figure below illustrates the multiple levels of learning and their interactions. Learning in organizations appears to be more calculative and structured, reflective of the way individuals seek to address the internal dilemmas they experience when they have to balance personal and organizational priorities in relation to learning (Antonacopoulou, 2006).





**Figure 4 Antonacopoulou, E. P. (2006). The Multiple Levels of Learning and Their Interactions.**

## 2.12 Organization Learning

OL is important aspect that most organizations struggle to implement or achieve, especially in a fast-paced industry such as health care. The definition of OL spans more than 30 years, with more recent exponential growth (Cohen & Sproull, 1996; Crossan & Guatto, 1996; Easterby-Smith, 1997). The stream of literature has had consistent debate over the meaning of OL. OL theory has been stagnant due to inconsistent terminology and a vast array of definitions despite many reviews of the OL literature overall (Argyris & Schön, 1996, 1996; Crossan, Lane, White, & Djurfeldt, 1999; Daft & Huber, 1987; Easterby-Smith, 1997; Fiol & Lyles, 1985; Huber, 1991; Levitt & March 1988; Shrivastava, 1983). OL is multi-level: individual, group, and organization.

Health-care organizations face the challenges of both learning what better practices exist and how to implement them. Knowledge in the health-care environment fluctuates rapidly, making it difficult to keep abreast of all potentially better practices. Transferring best practices across organizational boundaries is not a simple process in a hospital environment (Argote et al., 2001). Walter and Lopez (2008) concluded that physicians' perceptions of the threat to their professional autonomy are very important in their reaction to EHR adoption. Previous studies documented resistance to particular medical provisions (Meinert, 2005) or organizational changes (Spurgeon, 2003) on the basis that such changes might adversely affect professional autonomy. Physicians are concerned about the loss of their control of patient information and working processes given that the data assessed and shared by others. Lapointe and Rivard (2005) argued that when a system is introduced, users in a group will first assess the interplay between its features and individual and/or organizational-level conditions. The changes will disrupt the balance of power throughout the hospital. Therefore, exact replication of work processes is often not possible because of structural or operational differences between organizations (Spear, 2005). Hospitals, complex service organizations, face challenges when a physician face variable and unpredictable customer demands, their ability as individual service providers to figure out how to improve work processes are limited by lack of accountability and lack of perspective on the full set of work processes.

**OL background.** Before the late 1980s, research on OL flowed in three streams with little comingling of their waters. One stream of research illustrated how defensive routines prevent learning (Argyris & Schon, 1978). This work, which was primarily psychological, relied mainly on clinical case studies. Another stream of research, whose

source was in the work of Cyert and March (1992), conceived of learning as changes in the organization's routines, which affect future behavior. This work, which was sociological, relied mainly on simulations to develop theory. A third stream of research in the 'learning curve' tradition examined how characteristics of performance, such as errors or costs, changed as a function of experience (Dutton & Thomas, 1984). This work, which was conducted mainly by economists and industrial engineers, relied on archival field studies to estimate rates of learning. Although research in each stream has continued since the late 1980s, a co-mingling of the streams has occurred to some extent (Argyris, 1997; Miner & Mezias, 1996). The co-mingling as well as the outpouring of research on OL that has occurred in the last 20 years produced a large river of research on OL that is wide and has several deep streams.

**OL process.** OL requires organizations to explore and learn new ways, while concurrently exploiting what has been already learned (March, 1958). As Crossan et al. noted, "Recognizing and managing the tension between exploration and exploitation is one of the critical challenges of renewal and hence a central requirement in a theory of organizational learning" (p. 522). Indeed, the learning that has contributed to previous success may impede adaptation and renewal (Miller, 1990). OL has been profound to interconnect individual, group and organization level.

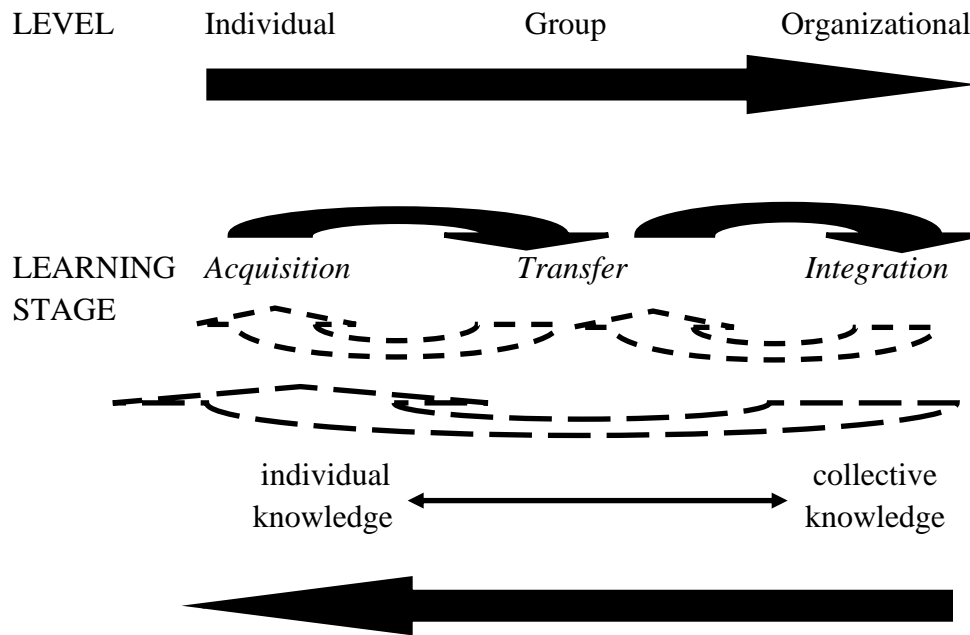
Organization level learning have supported the need for an institutionalization (Cangelosi & Dill, 1965; Duncan & Weiss, 1979; Fiol & Lyles, 1985; Hedberg, 1981; Huber, 1991; Levitt & March, 1988; Shrivastava, 1983; Stata & Almond, 1989). However, there are different views regarding the nature of learning at the organizational level. Some theorists view the organization as a collection of individuals—the human perspective—

while others view it as the systems, structures, and procedures of the organization—the non-human perspective. For those who view it as a collection of individuals, a distinction is often made about exactly who is represented in that collection: all members of the organization, or only the senior management group, sometimes referred to as the dominant coalition (Duncan & Weiss, 1979).

Crossan et al. (1999) suggested the organization is more than large-scale shared understanding. The translation of shared understanding into new products, processes, procedures, structures, and strategy. The non-human artifacts of the organization that endure even though individuals may leave. Furthermore, the organizational level captures the elements of strategic alignment. Ultimately, if OL is to provide a sustainable, competitive advantage (DeGeus, 1988), it needs to be linked to a competitive premise. Since the competitive landscape is constantly shifting, organizations need the capacity to renew themselves in a strategic sense (Quinn, 1992). Even with the best of intentions, individuals and organizations may learn the wrong things (Huber, 1991). Therefore, organizational learning is not simply whether individuals have learned something new, whether the organization is skilled at processing information (Huber, 1991), or whether the organization is skilled at developing new products (Nonaka & Takeuchi, 1995); it needs to be applied to a strategic context (Crossan et al., 1999).

Organization level learning involves embedding individual and group learning into the non-human aspects of the organization including systems, structures, procedures, and strategy. In this case, the stock of learning is what Huber (1991) referred to as organizational memory (Walsh & Ungson, 1991). Furthermore, this embedded learning needs to be aligned such that systems, structures, and procedures support a strategic

orientation that positions an organization within its competitive environment (Andrews, 1971). Organization level learning involves aligning systems, structure, strategy, procedures, and culture to build a competitive environment.



**Figure 5 Organizational Learning Process. (Jerez-Gomez, Céspedes-Lorente, & Valle-Cabrera, 2005)**

Argyris (1997) defines OL as the process of "detection and correction of errors" (p. 114). In Argyris' view, organizations learn through individuals acting as agents for them: "The individuals' learning activities, in turn, are facilitated or inhibited by an ecological system of factors that may be called an organizational learning system" (p. 117). Huber (1991) considers four constructs integrally linked to OL: knowledge acquisition; information distribution; information interpretation; and, organizational memory. Huber clarifies that learning need not be conscious or intentional.

### *Organization Capabilities*

OL is viewed as routine-based, history-dependent, and target-oriented (Levitt & March, 1988). Organizations are seen as learning by encoding inferences from history into routines that guide behavior (Levitt & March, 1988). OL is a process of increasing knowledge and innovating work routines through the inter-play of action and reflection that is more extensive than individually focused training and repetition (Edmondson, 2004).

### *OL Facilitators*

In concluding a review of the OL literature, Dodgson (1993) suggested that the organizational mechanisms that facilitate OL must be an area for research attention (Dodgson, 1993). Recently, the same concern was echoed by Vince et al. (2002) who suggested that our understanding of the antecedents of OL can be broadened through large-sample empirical research. Various organizational factors, such as culture and organizational systems and procedures, contribute to OL. This section discusses factors that empirical research has found to have facilitated OL. Keeping with our earlier discussion, we categorize them into two groups: internal to the firm and external to the firm and discuss them separately.

**Internal factors that facilitate OL.** The empirical research found that various organizational factors, such as culture, strategy, and structure, facilitate OL. Based on a study of technology adoption, Woiceshyn (2000) suggested that such factors as resources allocated to learning, motivation, incentives, shared values, and firm strategy influenced OL (Woiceshyn, 2000). In the following paragraphs, we discuss the various factors that have been found by the empirical research to influence OL.

*Learning from internal experience.* Empirical studies examined the phenomenon of experiential learning in various contexts using numerous measures. Experience was measured as age (Grewal et al., 2001; Soreneson & Stuart, 2000) and relevant cumulative experience (Darr et al., 1995; Gulati, 1999; Pisano et al., 2001; Powell et al., 1996) whereas learning was measured in terms of its outcomes, such as new acquisition (Baum et al., 2000), new alliance (Gulati, 1999; Powell et al., 1996), level of expertise (Grewal et al., 2001), innovation (Soreneson & Stuart, 2000), and productivity improvements (Darr et al., 1995; Pisano et al., 2001).

Studying the effect of learning by pizza makers, Darr et al. (1995) found that cumulative experience leads to productivity improvements. They concluded that a learning curve exists in service organizations as well although it is very weak, i.e. only 7% decrease in cost per every doubling of output vis-à-vis 20% in manufacturing firms. Further, it was found that in high-tech industries, older firms innovate more than their younger counterparts by building on their own past innovations (Sorensen & Stuart, 2000). A similar finding from the IT industry indicated that older firms are expert users of e-markets (Grewal et al., 2001). In another high-tech industry study, Powell et al. (1996) found that prior alliance experience increases the number of future alliances. Further evidence to the assertion that prior alliance experience increases future alliances was also found in a multi-industry and multi-country study (Gulati, 1999). In the context of international expansions, it was found that the longevity of a foreign expansion increases with previous experience in the host country (Barkema et al., 1996).

While cumulative experience leads to learning, time- and firm-specific factors also lead to OL. In a study of the automobile industry, Levin (2000) found the presence of a

learning curve, i.e. firms improved efficiency as a result of cumulative experience. However, their ability to improve product quality and reliability was related to time but not cumulative experience. Based on this finding, Levin suggested that quality is a function of time whereas efficiency is a function of cumulative experience (Levin, 2000).

Firms differ in their ability to learn from their experience and improve performance. Studying the adoption of minimally invasive cardiac surgery, Pisano et al. (2001) found that firms differed in their ability to adopt the new technology and improve performance. Although a cumulative effect of experience on performance improvement was found, the effect of individual firms was equally strong. Using qualitative data, they suggested that the differences arose due to better procedures and systems, cross-functional communication, leadership, and team work (Pisano et al., 2001). Therefore, accounting for firm-level differences in learning can better capture the phenomenon under investigation. Further, their study points to the need to use better measures for OL than the proxies such as age and cumulative experience.

Research that has focused on learning from internal experience suggests that firms benefit from the cumulative experience. These benefits accrue in the form of productivity improvements (Darr et al., 1995) and increased availability of alliance partners (Gulati, 1999; Powell et al., 1996). In the context of international expansion, it was found that the longevity of a foreign expansion increases with previous experience in the host country (Barkema et al., 1996).

Although there appears to be a consensus that cumulative experience leads to learning, research has suggests that firm-specific factors affect learning. In a study among firms that adopted minimally invasive cardiac surgery, Pisano et al. (2001) found that while



cumulative experience had improved performance, the effect of individual firm characteristics was equally strong. Using qualitative data, they suggested that the differences were due to the procedures and systems, cross-functional communication, leadership, and team work (Pisano et al., 2001). This study points to the need to use better measures for OL than proxies, such as age and cumulative experience. Further, it points to the need to account for firm-level learning processes to better understand OL.

### **2.13 Individual Learning**

Individual learning refers to knowledge acquisition, which can occur only when individuals have both the ability (“can do”) and the desire (“will do”) to acquire new knowledge (Noe, 1986; Wexley and Latham, 1991). Organizational learning has its roots in individual learning (Shrivastava, 1983; Senge, 2006). Psychologists, linguists, educators, and others have heavily researched the topic of learning at the individual level. Researchers have discovered that cognitive limitations as well as the seemingly infinite capacity of the human mind to learn new things (Restak, 1988). Senge (2006) suggests that learning and the pursuit of personal mastery needs to be an individual choice, therefore enforced take-up will not work. What an individual learns in an organization greatly depends on what is already known by the other members of the organization in other words, on the common knowledge base (Simon, 1991). There has been valuable work addressing individual and social aspects of learning, few studies have integrated these aspects and examined their interrelationships empirically (Lähtenmäki et al., 2001). Individual learning of a technology system is a complex challenge for most individuals. The desire to learn the technology might be strong, but the individual skills could be deficient. Attwell (1992) argues that learning and communicating the technical knowledge required to use a

complex innovation successfully places far greater demands on potential users than the organization.

According to Argyris (1997), individual learning takes place when new knowledge is acquired as a result of the transformation of existing experiences. Kim (1993) claims that individual learning happens through experiences and observations. Marsick and Watkins (2003, p. 135) identify individual learning, which is placed among cognitive processes, with the selective retention of experiences. Hence, individual learning will not generate benefits for an organization if it is not changed into learning at an organizational level. Thus, individual learning is equally as important for an organization as it is for the workers themselves. Individual learning is a basis of learning at an organizational level (Yang 2009; Campbell & Armstrong 2013).

The two levels of learning termed operational and conceptual learning. Operational learning represents learning at the procedural level, where one learns the steps to complete a particular task (Gallagher & Fellenz, 1999). The know-how is captured as routines, such as filling out entry forms, operating a piece of machinery, handling a switchboard, and retooling a machine (Kim, 1993). Operational learning can accumulate and change routines, but routines affect the operational learning process as well. Conceptual learning refers to the thinking about why things are done in the first place, sometimes challenging the very nature or existence of prevailing conditions, procedures, or conceptions and leading to new frameworks in the mental model (Cegarra-Navarro & Rodrigo-Moya, (2003). Excellent example, everyone develops a daily route to and from work which usually becomes a routine. This scenario refers to operational learning. One day, when you are driving home, you notice that road construction is interfering in routine and

congestion is causing major delays. You will rethink your criteria of what the best route home means and select a new route. This scenario refers to conceptual learning.

Scholars often assume that learning, whether it be at the individual, group, or organization level, is a conscious, analytical process (Crossan, Lane & White, 1999). Individual level learning, in organization literature, refers to individual competence, capability, and motivation to undertake the required tasks (through using intuition). Learning takes place through the process of intuiting. Intuiting refers to the preconscious recognition of the pattern and/or possibilities inherent in a personal stream of experience (Weick, 1995b: p. 2). In this case, individual learning is seen as an individual ability to perceive similarities and differences- patterns and possibilities. The process of intuiting acknowledges the role of tacit knowledge (Polanyi, 1967) and expertise (Behling & Eckel, 1991; Prietula & Simon, 1989). Crossan (2002) argues that individuals develop new insights and begin to crystallize them through the process of interpreting by developing cognitive maps. The cognitive maps represent a collection of knowledge, which represent individual knowledge and competencies (Bertini & Tomassini, 1996). Research suggests that individuals that use intuition will no longer have to think consciously about his or her actions. Having been in the same, or similar, situations and recognizing the pattern, the expert knows, almost spontaneously, what to do (Crossan, Lane & White, 1999).

Most individual learning literature acknowledge that competence and capability play a key role in the process of learning (Aragón, Jiménez & Valle, 2014). Individuals require both motivation and direction or focus. It is the interconnection between what individuals can do (capability), what they want to do (motivation), and what they need to

do (focus) that enhances individual learning (Watkins & Marsick, 1993). Individual learning capability refers to the individuals' competencies and motivation to learn (Bontis et al., 2002) and it is reflected in some individual behaviors such as generation of new insights and to be aware of critical issues that affect one's work, as well as have a sense of pride and ownership in one's work, etc. (Bontis et al.,2002).

#### **2.14 Antecedents to Individual Learning**

**Absorptive capacity.** Absorptive capacity refers to individuals' ability to recognize the value of new and external knowledge, assimilate it, and apply it based on previous related experience and knowledge (Cohen & Levinthal, 1990; Griffith et al., 2003; Szulanski, 1996). Absorptive capacity can influence an organization or an individual. In this research, we will focus physician's absorptive capacity. Individual users' absorptive capacity does play a significant role in the knowledge-transfer process. Mowery and Oxley (1995) conceptualized absorptive capacity as a broad set of organization member skills needed to deal with the tacit component of transferred knowledge and needed to modify this imported knowledge. Park (2007) extended the conceptualization of user absorptive capacity as the ability of an organizational member to value, assimilate, and apply new knowledge. Cognitive science on individual learning discusses how development of new cognitive structures follows two alternative processes: assimilation and transformation (Marshall, 1995; Piaget, 1952). Individual users' absorptive capacity does play a significant role in the knowledge-transfer process. Absorptive capacity is fundamentally a function of the individual existing accumulation of knowledge prior to the transfer. Research suggests that absorptive capacity is positively related individual learning (Galbraith 1990; Hamel 1991).

**Knowledge sourcing initiative.** Levitt and March (1988) defined knowledge sourcing as the “extent to which individuals intentionally access other’s expertise, experience, insights and opinions” (Gray & Meister, 2006, p. 821). In this study, we explore how physicians increase their individual learning of the EHR system through knowledge sourcing. Knowledge sourcing research is rooted in the demand perspective of individual learning (Gray & Meister, 2004), such individual-level behaviors are key to the success of understanding and creating routines (Wang, Gray, & Meister, 2014). In healthcare organizations, specialists and sub-specialists are likely to share knowledge with referring physicians who are sources of business, but they may be reluctant to share knowledge with or train competitors. Hence, the hospital competitive environment, constraints individual learning from a knowledge sourcing perspective.

Researchers have made efforts to develop theory surrounding knowledge sourcing behavior (Gray & Meister, 2004; Gray & Meister, 2004; Lin, Kuo, Kuo, Ho & Kuo, 2008), empirical research has begun to explore the factors that influence knowledge sourcing in general. The work of knowledge sourcing draws from social–psychological theories that invoke various individual or contextual elements to account for knowledge contribution and retrieval (Durcikova & Fadel, 2014). Gray and Meister (2006) studied the effects of seeking knowledge from individual co-workers, groups of co-workers, and internal published materials. Bock et al. (2006) found that collaborative norms facilitate individuals’ knowledge seeking from electronic knowledge repositories. Regardless of what an organization does to manage knowledge, benefits are only achievable when individuals actively draw on knowledge resources to enhance their performance.

**Learning orientation.** Learning orientation indicates individuals' predisposition to constantly construct and refine the knowledge acquired (Kankanhalli, Pee, Tan, & Chhatwal, 2012). Learning orientation refers to people's desire to increase competence by developing new skills and taking up challenging tasks (Bell & Kozlowski, 2002). A learning orientation is also an internal mind-set that motivates an individual to develop his or her competence (Dweck, 1986; Dweck & Leggett, 1988); therefore, it stands out as an important internal drive for enactive mastery. Gong (2006) suggest that a learning orientation has also been shown to enhance cross-cultural adjustment, which involves the acquisition of culturally novel skills and behaviors.

The conceptualization of learning organization demonstrates two focuses: some scholars emphasize concrete information generation and dissemination systems as the mechanism through which learning takes place (Huber, 1991), while others consider firms as 'cognitive enterprises' and call for the need for a shared mental model, a shared organizational vision, and an open-minded approach to problem solving (Senge, 2006). Individuals with a learning orientation seek challenges that provide them with learning opportunities (Ames & Archer, 1988). Research suggests that a learning orientation is conducive to the acquisition of knowledge and skills (Brett & VandeWalle, 1999; Kozlowski, Gully, Brown, Salas, Smith, & Nason, 2001).

**Motivation to learn.** Individual differences in ability and motivation to learn have long been considered important predictors of learning effectiveness (Campbell, 1989; Goldstein, 1993; Noe, 1986; Noe & Schmitt, 1986). Learning motivation has been defined as the willingness to attend and learn material presented in a developmental program (e.g., Noe, 1986). It is a key determinant of the choices individuals make to engage in, attend to,

and persist in learning activities (Klein, Noe, & Wang, 2006). Colquitt (2000) also conceptualization motivation to learn as “the direction, intensity, and persistence of learning directed behavior. Goldstein (1992) found a positive relationship between motivation to learn and trainees’ scores on learning measures. Later, Colquitt et al. (2000) indicated that motivation to learn had a positive relationship with learning performance.

Individuals who are motivated when they approach a learning situation clearly have a higher likelihood of achieving positive outcomes than those with a lower level of motivation (Goldstein, 2001). In this case, physicians with high motivation would more likely succeed with individual learning that would allow them to develop routine use of EHR system. Whereas ability accounts for what individuals can do, motivation to learn influences the decision-making processes determining the direction, focus, and level of effort individuals will apply to a learning activity (Noe, Wilk, Mullen, & Wanek, 1997).

### **2.15 Environment Turbulence**

Environmental turbulence refers the magnitude of changes in the levels of key environmental variables as well as the unpredictability of future levels of those variables (Hanvanich, Sivakumar, Tomas & Hult, 2006). Turbulence equate to unpredictable environment conditions. Hospitals in uncertain times attempt to be on the cutting edge to secure the inputs their organization requires to function. For hospitals, critical resources include patients and the revenue that is collected based on their service. Changes in the external regulatory environment have created turbulence in the internal hospital environment (Salyer, 1995). This research study will examine the moderating role of environment turbulence on the relationships between individual learning drivers and EHR routinization. Extensive research has documented how individual learning are related to

organizational performance. EHR routinization can improve a hospital's performance: reduce medical errors, better patient information, and improve quality.

## **2.16 Summary**

Learning can be seen as increasing one's capacity to take effective action (Kim, 1993). IL is important for embedding and refining valuable routines and changing unhelpful ones (Greenhalgh, 2008). Health-care organizations can gain value from developing and establishing routine in patient care. IL can assist physicians in challenging new and old routines and find a way to negotiate an acceptable way of working. For example, do we always need three people to have input on ordering blood tests? All physicians need to learn to capture knowledge about internal activities, reflect on that knowledge and adjust their systems and processes accordingly (Gavin, 2008). An organization learns through its individual members and, therefore, is affected either directly or indirectly by individual learning (Kim, 1993). Organizations are made up of individuals, and there is no organization without individuals (Felin & Foss, 2005). Individuals are active framers, cognitively making sense of the events, processes, objects, and issues that make up organizational life in a way that links with their personal and professional identity (Weick, 1995). Individual's cognitive frames are continually shared and negotiated, enabling them to accommodate the frames of others and allow the organization to better embrace innovation and change (Weick, 1995).

Conversely, where IL is underdeveloped or suppressed, counterproductive defensive routines become entrenched (Argyris, 1985). Practically all empirical research on individual routines has been conceptual and theoretical (Felin, Foss, & Ployhart, 2015). Most research on individual routines tend to focus on its relevance and how it compares to



organization routines. This research will build on the routine literature and create opportunities to develop a routinization theory, which will open up an exciting new agenda for empirical research in health-care organizations that links human action and interaction with organizational and institutional change (Giddens, 1984).

## **CHAPTER III**

### **HYPOTHESES DEVELOPMENT**

Chapter three presents the hypotheses development section of this proposed study. The chapter will present a review of the Constructs, Research Hypotheses, and Research Model. Chapter two provided an extensive literature review with the goal of presenting crucial elements as building blocks to evaluate EHR routinization, OL, individual learning, and environmental turbulence. Prior reviews have dealt primarily with theoretical analysis as there had been little empirical research to review. Most reviews raised concerns about the lack of empirical research (Easterby-Smith, 1997; Huber, 1991) and frequently called for systematic empirical research (Miner & Mezas, 1996; Vince, Sutcliffe, & Olivera, 2002).

Routine literature informed this research about the importance of routinization, its elements and gaps, as the concept applies to health care. Routinization illustrates how technology can become structured, tightly coupled, and stabilized. Health-care organizations rely on routinization to alleviate inconsistent use of the system, inaccurate data input and to medical errors due to data issues. Routinization removes guessing from the workflow process. IL can foster the process of learning in the work routines. Lastly, routinization has the potential to positively impact health care by reducing medical errors

and improving experiences that can be gained through appropriate use of the information system.

The notion of routines is at the heart of behavioral studies of organizations (Cyert & March 1963; Nelson & Winter, 1982). Routines are the means by which individuals carry out activities by matching appropriate procedures to situations they face, whether ordinary or extraordinary. This process of matching generally does not involve rational choices between alternatives but is rather the enactment of processes that are seen as suitable and legitimate given a recognized set of circumstances. Routines include a wide variety of phenomena: rules, procedures, strategies, technologies, conventions, cultures and beliefs around which organizations are built and through which they operate. At any one moment, the routines enacted by individuals and subunits in an organization are those that have been selected as being advantageous through a process of experience and learning. These activities, which are geared to the operational functioning of the organization, have been referred to as operating routines (Zollo & Winter, 2002). Routines are modified or adapted when the individual experiences novel situations for which appropriate procedures have not yet been developed, when existing routines prove to be unsuccessful, or when alternative routines which promise greater advantages are discovered internally or externally (Gavetti & Levinthal, 2000). In these situations, routines are adapted incrementally in response to feedback about outcomes (Levitt & March, 1988). Routines can be a challenge in a complex organization. Routines are built through individual learning and experiences. This study investigates how physicians utilize individual learning to create routines in the EHR system.

Individual learning influences organizational learning through shaping the organization's shared mental models (Senge, 2006). Mental models represent a person's view of the world, including explicit and implicit understandings (Zahra & George, 2002). In knowledge-intensive environments, such as research units in information technology (IT), hospitals, firms or in universities, individual learning is key to organizational performance (Kankanhalli, Pee, Tan, & Chhatel, 2009). Hence, learning can be difficult, and its effectiveness is likely to depend on a combination of individual factors such as motivation to learn and absorptive capacity. Several researchers suggest (Argote, Beckham, & Epple, 1990; Kim, 1993) that organizations are able to learn from the skills, approaches and commitment of individual members. Learning is crucial when an organization is tasked with developing new work routines. Learning occurs when an organization gathers insight from employees past experiences. These experiences can be positive or negative. Hence, individual learning has the potential to turn experiences into new knowledge for an organization. Tempest & Starkey (2004) suggests that individuals learn to make sense of the rapid changes in a complex environment and create narratives about their work that are meaningful to them. Individual learning involves the concentration of an individual experience regarding a technology into understandings that may be viewed as personal skills and knowledge (Attewell, 1992).

Individual learning can play a major role in the development of routinization in an organization. Physicians willingness to learn can assist hospitals in creating form processes in the EHR system. Kim (1993) refers to individual learning as the acquisition of skill or know how. Argyris (1997x) argue that learning takes place only when new knowledge is translated into different behavior that is replicable. Kolb refers to learning as the process

whereby knowledge is created through the transformation of experiences. All of these definitions demonstrate the importance of individual learning in an organization. Learning can't occur in the organization, if there no individuals willing to learn and create new knowledge. Researchers in the area of learning have begun to embrace the view that individual learning is linked to organizational learning (Fiol & Lyles, 1985; Hayes & Allinson, 1998; Kim, 1993). Learning takes place only when new knowledge is translated into different behavior that are replicable (Argyris and Schon, 1996). Organizational learning is built out of the individual learning of members in an organization. Individual learning influences directs or indirects, the way organizations learn and provides justification that many theories on organizational learning are based on observations of individual learning and of the organization–individual analogy (Kim, 1993). The study argues that physician knowledge directs the way the hospital learns. Physicians are responsible for learning the daily workflows and creating new knowledge. Organization learning stems from the knowledge acquisition of the individuals and progresses with the exchange and integration and progresses with the exchange and integration of the knowledge until a body of collective knowledge is created (Fiol & Lyles, 1985). So, we can conclude, the organizations ultimately learn via their individual members. IL is crucial to building routines in the hospital environment.

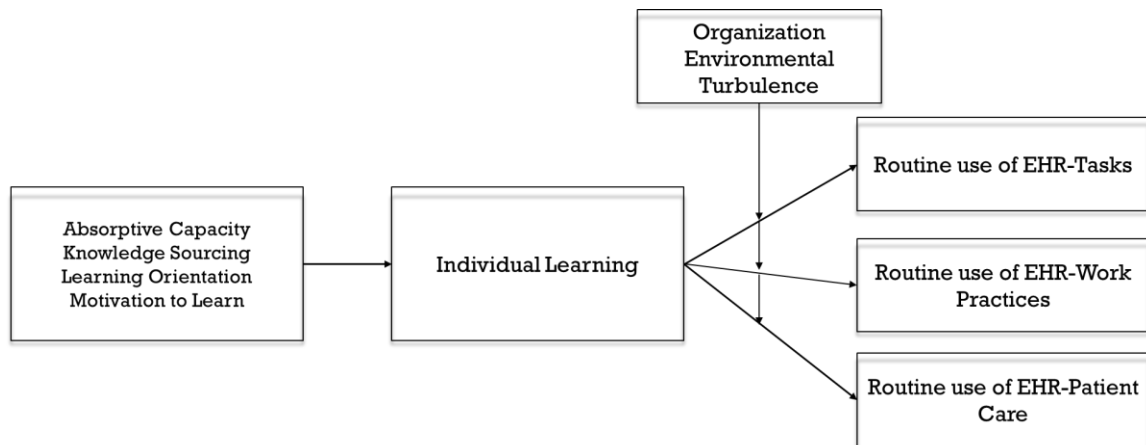
While physicians are challenged with using the system appropriately, physicians are also dealing with changes to federal legislation called meaningful use guidelines. Most recently, we have seen the President try to overturn the Affordable Care Act. If the act is passed, 14 million more people would be uninsured under the legislation than under current law (Rosenfield, 2017). This means that 14 million people will not visit the doctor regularly

for preventive care and hospitals will deal with more life and death situations. Hospital will face more fiscal challenges, if the Affordable Care Act is overturned. The fiscal challenges will derive from non-payment of services and write offs. Cichon (1997) state that, “The public payer sector has experienced the greatest amount of environmental uncertainty in recent years” (p. 71) because Medicare and Medicaid often reimburse hospitals at prices below the cost of providing services. This study will also look at how environmental turbulence will influence routinization. Hospitals in uncertain times attempt focus on critical resources to secure the inputs that their organization requires to function. For hospitals, critical resources include patients and the revenue that is collected based on their service. Hospitals are faced with rapid changes; consequently, existing knowledge can become quickly obsolete or even impede new knowledge creation. Because knowledge is not long-lasting in the presence of high turbulence organizations. A hospital ability to improve existing skills and learn new ones becomes crucial (March 1991). This research argues that EHR routinization is key to achieving the promised benefits of EHR implementations such as increase in efficiency, improvements in the quality of care, and reduction in medical errors. In this research, EHR routinization is defined as a stage where the EHR system is no longer perceived as being new or out-of-the-ordinary and has become institutionalized. For any new technological innovation such as EHR to be routinized, physicians support and willingness to learn about the system are critical. Hence, this research draws from the literature on individual learning to understand factors that influence EHR routinization. Specifically, this research examines the impact of physicians’ individual learning (knowledge acquisition, which can occur only when individuals have both the ability (“can do”) and the desire (“will do”) to acquire new knowledge).) Further,

(i) given the dearth of empirical research on the factors that influence physicians' individual learning in the context of EHR routinization and (ii) the need to understand the antecedents of physicians' individual to be able to provide meaningful guidance to researchers and practitioners dealing with EHR routinization challenges, this research studies the antecedents of individual learning by physicians. Furthermore, we posit that environmental turbulence has a moderating influence of on the relationship between individual and EHR routinization.

As a result, individual learning, hospital EHR mandate, turbulence environment, and routine use of EHR, are included in the model. Figure 1 presents the research model.

### 3.1 Research Model



### 3.2 Variable Definition

The adoption of Electronic Health Records (EHR) has potential to reduce medical errors, duplication of testing, and delays in treatment. One of the ways EHRs can perform its associated task is through formalized business processes. Though EHR implementation

has been on rise, studies find that the result of EHR implementations have been mixed (Buntin, Burke, Hoaglin & Blumenthal, 2011; Terry et al., 2008). Recent research shows that health care professionals often use non-standard practices and work arounds that circumvent the EHR to complete their work. Although workarounds may seem necessary to physicians and are not perceived to be problematic, they can pose a threat to patient safety and hinder the potential benefits of EHRs. This research argues that EHR routinization is key to achieving the promised benefits of EHR implementations such as increase in efficiency, improvements in the quality of care, and reduction in medical errors. The quality and efficiency of health care delivery is heavily dependent on the efficacy of the daily routines for creating, accessing, modifying, and using patient health records. Daily routines are heavily reliant on physician's management of the patient records.

Physicians have a unique group culture in the hospital environment (McAlearney, Fisher, Heiser, Robbins & Kelleher, 2005). Culture and values plays a significant role in how physicians perceive the information technology (Lapointe & Rivard, 2005). The organization's culture has an impact on any organization-wide change in tools, processes, or systems. Routinization is more successful if physicians have clearly defined what the new technology means to the organization and have communicated this meaning to all stakeholders (i.e., clinicians and nurses) (Wurster, 2009). Traditionally, physicians are more inclined to talk and share their experiences with one another. Whether or not they support and use EHRs will have a great influence within the physician group and outside the group (i.e., nurses and administrative staff). Several physicians can have great influence over whether routinization is established in one organization. When specific orientations are embedded in organizational culture, the intensity and consistency of resultant behaviors



are augmented across situations, groups, and persons within the firm (Hult, Hurley, & Knight, 2004).

The following definitions have been set forth to conceptualize the research model:

- *Routine use of EHR: regular and standard use of EHR systems by health care professionals, whereby the EHR system is no longer perceived as being new or out-of-the-ordinary (Saga and Zmud, 1993).*
- *Individual learning refers to knowledge acquisition, which can occur only when individuals have both the ability (“can do”) and the desire (“will do”) to acquire new knowledge (Noe, 1986).*
- *Absorptive capacity refers a learner’s mental representation and indicates the ability to acquire new knowledge by relating it to existing knowledge (Kankanhalli et al., 2012).*
- *Knowledge sourcing initiative refers to individuals’ intentional efforts to locate and access others’ expertise, experience, and viewpoints (Kankanhalli et al., 2012).*
- *Learning orientation refers to the individual’s desire to improve competence by acquiring new skills and overcoming challenges (Kankanhalli et al., 2012).*
- *Motivation to learn refers to an individual’s attitudes toward job involvement that have an effect on both learning and its applications to the job (Noe, 1986).*

### **3.3 Moderators**

The passage of the ARRA of 2009, the HITECH Act within it, and the ACA of 2010, as well as the definition of meaningful use of electronic health records as part of the ARRA, a significant amount of federal funds and attention has been given to the implementation of a Nationwide Health Information Network (NHIN) (Baker, 2011). The

purpose of the NHIN is to connect providers and consumers for the timely and secure exchange of patient information (cdc.gov). Meaningful use is defined by the use of certified EHR technology in a meaningful manner (for example, electronic prescribing); ensuring that the certified EHR technology is connected in a manner that provides for the electronic exchange of health information to improve the quality of care; and that in using certified EHR technology the provider must submit to the Secretary of Health & Human Services (HHS) information on quality of care and other measures (cdc.gov). Congressional requirements for meaningful use are as follows: (a) use of a certified EHR in a meaningful way, (b) use of an EHR that can exchange information with other systems electronically, (c) submission of reports to CMS that include performance measures proving meaningful use, and (d) direct engagement of patients in their care (Ralston, Coleman, Reid, Handley, & Larson, 2010).

The concept of meaningful use rested on the '5 pillars' of health outcomes policy priorities, namely (Hsiao, Decker, Hing, & Sisk, 2012):

- Improving quality, safety, efficiency, and reducing health disparities
- Engage patients and families in their health
- Improve care coordination
- Improve population and public health
- Ensure adequate privacy and security protection for personal health information.

Research has documented how individual learning is related to organizational performance (Gould, 2009). EHR routinization can improve a hospital's performance: reduce medical errors, better patient information, and improve quality. One objective of this study is to examine the moderating role of turbulence on the relationship between individual learning

and routine use of EHR. Turbulence equate to environment conditions. Turbulence is the extent to which environments are being disturbed by an increasing rate of exchanges between factors (Vohra, 2015). Physicians deal with the changes in their environment on a daily basis such as regulation changes, technology changes and managing patient relationship. Environmental conditions could affect a physician's ability to establish routines in the EHR system.

- *Environmental turbulence refers to the magnitude of changes in the levels of key environmental factors as well as the unpredictability of future levels of those factors (Hanvanich et al., 2013).*

### **3.4 Hypotheses Development**

The relationship between individual and organizational learning remains one of the contested issues in organizational learning debates (Antonacopoulou, 2006). Some agreement exists that distinctions must be made between individual and organizational learning (Fiol & Lyles, 1985). Individuals are important to organizational learning; however, this doesn't mean organizational learning equates to the sum of individual learning. Organizations unlike individuals, develop and maintain learning systems that not only influence their immediate members, but are then transmitted to others by way of organization histories and norms (Lawrence & Dyer, 1983; Mitroff & Kilmann, 1976). Several contributions have exposed researchers to the interdependencies, differences, possibilities and challenges involved in aligning individual and organizational learning agendas (Antonacopoulou, 1998; Friedlander, 1983; Kim, 1993).

OL requires that management recognize the relevance of individual learning, thus developing a culture that promotes the acquisition, creation, and transfer of knowledge as

fundamental values (Garvin, 1993; McGill et al., 1992; Nonaka & Takeuchi, 1995; Stata, 1989). Management have to articulate a strategic view of learning, making it a central visible element and a valuable tool with an influence on the obtaining of long-term results (Hult & Ferrell, 1997; Slocum et al., 1994). Strategic leadership for learning involves identifying a leader and champion to support learning as well as using learning as a strategic goal to drive business results (Marsick & Wakins, 2003). A true learning organization incorporates the facilitation of learning, encourage team building, staying up-to-date with research, thus acquiring new knowledge and periodically changing to maintain best practices. In this type of institution, creativity, risk taking, and experimentation is valued and contributes to creating a strong learning culture. Management should eliminate old beliefs and mental models that may have helped to interpret reality in the past but may now be seen as obstacles in as much as they help to perpetuate assumptions that do not correspond to the current situation.

Kontoghiorghes (2005) suggests that organizational learning is established by designing work so that employees can learn on the job and create opportunities to provide for ongoing education and growth. Strategic leadership for learning involves identifying a leader and champion to support learning as well as using learning as a strategic goal to drive business results (Marsick & Wakins, 2003). Hospitals should focus on incorporating the facilitation of learning, encourage team building, staying up-to-date with research, thus acquiring new knowledge and periodically changing to maintain best practices. Individuals' learning is significantly affected by organizational practices and managerial learning practices, which reflects the organization's orientation towards learning (Antonacopoulou, 2006).

### **3.5 Hypotheses**

Hospitals historically have relied on a dedicated, highly skilled professional workforce to compensate for any operational failures that might occur during the patient care delivery process (Tucker & Edmundson, 2003). Health care organizations are highly knowledge-intensive institutions that require continual learning at the individual level to improve their capabilities (Tsai, 2014). Excellent physicians have been the means for ensuring that patients receive quality care. Physicians are well positioned in these efforts to help their organizations learn, that is, to improve clinical outcomes and routines by suggesting changes in processes and activities based on their knowledge of what is and is not working (Sitkin, 1992). Individual learning demonstrates the physician ability and desire to build routines in the EHR system. Physicians are in the right position to be a champion and lead the organization in building routines. Routines are increasingly becoming recognized as an essential component to successful integration of EHR technology. Clinical workflow is often characterized in terms of the pattern of actions clinicians utilize to perform routine tasks and generate results (Lee, Jason & Shartzler, 2005).

Physicians are responsible for working through the complexity of diverse tasks associated with the EHR system. Most physicians have expressed concerns over EHR implementations and the potential impact it may have on routine workflow and productivity (Rosenthal, 2007). However, the enactment of meaningful use has forced physicians to think about how daily routines are integrated within the EHR technology. For example, physicians have the painstaking task of developing strategies to address latent issues that may impede workflow before, during, and after implementation (Lorenzi, Kouroubali, Detmer & Bloomrosen, 2009). Without appropriate selection of training on

the EHR system, physicians run the risk of having the EHR system negatively impact workflow and productivity and ultimately neglect the development of routines (Nembhard, Alexander & Hoff, 2009).

Antecedents of Individual Learning

### **Absorptive Capacity**

Many studies have examined the effect of an organization's absorptive capacity on organizational performance, including the adoption of new technology (Nicholls-Nixon, 1993), the transfer of technological knowledge (Reagans, 2003), the development of new products (Stock, 2001), and organization learning (Lane, 2001). Boynton et al. (1994) asserted that a firm's absorptive capacity provides the theoretical basis for comprehensive understanding of its usage of IS. Zahra and George (2002) suggested that absorptive capacity was an important factor for an organization to implement new IS successfully and individual level prior knowledge and management support were both critical. Knowledge capital is becoming more important to healthcare establishments, especially for hospitals facing changing societal and industrial patterns (Tsai, 2014).

Individual users' absorptive capacity, however, does play a significant role in the knowledge-transfer process. Cohen and Levinthal (2000) defined the absorptive capacity as the ability of an organizational member "to value, assimilate, and apply new knowledge" (p. 128). Cohen (2000) suggests that effective absorptive capacity, whether it be for general knowledge or problem-solving or learning skills, it is insufficient merely to expose an individual briefly to the relevant prior knowledge. It is critical to have intensity, in order, for absorptive capacity to be effective. The more complex and abstruse the knowledge, the more tacit and explicit knowledge must exist together for knowledge to be usable (Schultze

2000). Zahra and George (2002) further conceptualized user absorptive capacity as “a set of organizational routines and processes by which firms acquire, assimilate, transform, and exploit knowledge to produce a dynamic organizational capability” (p. 185). This study defines absorptive capacity as a learner’s mental representation and indicates the ability to acquire new knowledge by relating it to existing knowledge (Kankanhalli et al., 2012).

EHR requires most physicians to acquire new knowledge. EHRs systems require a fair amount of user knowledge and aptitude, which can cause hardships for those who weren't trained to use the technology (Fisher & Feigenbaum, 2013). If hospital employees are knowledgeable regarding the EHR technology, they are likely to be better capable of dealing with EHR technology (Lin & Lee, 2014). It is the recognition that what is utilized is what needs to be shared – as it takes into account both explicit and tacit components of knowledge. Knowledge in this situation can be gathered over time to form routinization. In most cases, hospitals have decided to roll out EHR without formal training (i.e., University Hospital, Cleveland). Routines positively influences the knowledge creation process. Jansen et al. (2005) found a moderate positive relationship between formalization and routinization to the capability of the organization to transform newly acquired knowledge. Physicians will acquire a knowledge through repetitive task or routines. Established routines are therefore strongly related to knowledge reuse and in the continuous exploitation of the current knowledge base (Crossan et al., 1999; Jansen et al., 2005). Such knowledge is usually tacit in nature, giving the individual the ability to intuitively recognize how new technological knowledge can be applied in the organization (Crossan et al., 1999). Hence, this study hypothesizes:

**H1: Absorptive capacity will positively influence physician individual learning**

## **Knowledge Sourcing**

Knowledge sourcing initiative refers to an individuals' intentional efforts to locate and access others' expertise, experience, and viewpoints (Kankanhalli et al., 2012). Learning theories have approached knowledge seeking from the standpoint of attaining learning outcomes. Previous literature has suggested that knowledge seekers acquire knowledge so as to learn from the experience of others (Wasko and Faraj 2000). Gray & Meister (2004) examined the effect of knowledge sourcing on individuals' learning outcome. Individuals that are knowledge sourcing are typically looking to others for their advice (based on their professional experience) and looking for sensory input and/or factual data (Gray & Meister, 2004). Researchers have found that job characteristics (intellectual demands of the job) and individual characteristics (learning orientation) determine knowledge sourcing behavior, which in turn influences learning outcomes (Bock, Kankanhalli & Sharma, 2006). Another study along this perspective (Borgatti & Cross, 2003) examined the influence of the contributor-seeker relation on information seeking probability.

EHR has been abruptly introduced into the health care environment. This means some physicians have not received the appropriate training. When a physician is searching for an answer related to EHR. He or she is more likely to rely on other physicians. Physician can identify with other physicians with relevant EHR knowledge resources, and how and when they can be reached. The decision to seek information from someone in the face of a new problem or opportunity is likely affected by one's perception of another person's expertise (Fiske & Taylor, 1984). Physician's culture is very close knit. Most physicians value the opinion of other physicians. However, knowing that someone else has valuable



expertise is important, but their knowledge is really helpful only if they are accessible. Health care today is mainly knowledge-based, and the diffusion of technology knowledge is imperative for proper utilize of EHR (Kilo, 2005). Information resources are used by physicians to supplement their knowledge and clinical experience and to keep themselves up to date (Dawes & Sampson, 2003). Electronic clinical information resources continue to expand in accessibility and are an important reference for both physicians. However, physician's resources are obstructed by many limitations, such as usability and relevance to clinical tasks. For example, an EHR system's performance is dependent on the ability of a user to properly navigate the computer screen, understand the data that has been inputted and provide appropriate updates. Physician's information needs are often unmet and there are multiple reasons preventing physicians from meeting those needs, such as lack of time and skills to complete searches efficiently and lack of integration in the search process into clinician workflow (Ely et al., 2002). Hence, this study hypothesizes:

**H2: Knowledge sourcing will positively relate to physician individual learning.**

### **Learning Orientation**

Learning orientation indicates the individual's desire to improve competence by acquiring new skills and overcoming challenges (Nonaka, 1995). A learning orientation is an internal mind-set that motivates an individual to develop his or her competence (Dweck, 1986; Dweck & Leggett, 1988); therefore, it stands out as an important internal drive for enactive mastery. Individuals with a learning orientation seek challenges that provide them with learning opportunities (Ames & Archer, 1988). Both internal personal factors and external situational factors affect acquisition of knowledge and skills (Bandura, 1986).

Research suggests that a learning orientation is conducive to the acquisition of knowledge and skills (e.g., Brett & VandeWalle, 1999; Kozlowski et al, 2001).

EHR is a challenge for most physicians because it changes the workflow process, daily routines, and require up-to-date computer skills. EHRs systems require a fair amount of user knowledge and aptitude, which can cause hardships for those who weren't trained to use the technology (Fisher & Feigenbaum, 2013). There is a learning curve for all staff members as it relates to EHR. It was also found that learning to use the system and taking care of the patients at the same time can be difficult and initial formal training was usually insufficient (Holden, 2011). Hospital must allot time and training on learning how to use an EHR system. However, the demands and pressures of delivering office-based care may not afford them the time to learn the system (Simon et al., 2007). Physicians have to learn how to use the EHR system effectively and efficiently which they see as a burden. Given this situation, physicians must have a desire to improve his or her competences and gain new skills. Most physicians must make the time to learn an entirely new system and use it effectively and efficiently. Hence, this study hypothesizes:

**H3: Learning orientation will positively relate to physician individual learning.**

#### **Motivation to learn**

Motivation to learn refers to an individual's attitudes toward job involvement that have an effect on both learning and its applications to the job (Noe, 1986). Traditionally, most research regarding motivation to learn has been conducted in educational settings in which academic achievement and knowledge acquisition are of primary concern (e.g., Chapman, Cullen, Boersma, & Maguire, 1981; Kahn; Marjori-Banks, 1976). A limited number of studies have investigated the relationship between motivation to learn and individual learning. Motivation to learn is a key determinant of the choices individuals

make to engage in, attend to, and persist in learning activities (Noe, 1986). Significant research confirms Maier's contention (1973) that when individuals with the requisite ability will perform poorly if their motivation is low. While high motivation to perform will result in more learning (Baldwin, Magjuka, & Loher, 1991; Martocchio & Webster, 1992). Individuals who expect positive benefits from using computers would be expected to be more highly motivated than those who do not expect positive benefits, and to persist more in their attempts to learn (Compeau & Higgins, 1995).

If a physician has the motivation to learn, they are more likely to be better capable of dealing with EHR technology (Lin & Lee, 2014). Research shown that physicians are not motivated to learn the EHR system because it interferes with their existing work routines (Boonstra, 2010). Some hospitals are improving motivation of health care professionals to learn and train on using EHRs by providing them with direct and indirect incentives, including overtime payments, bonuses and rewards for the hospital sections and departments successfully implementing EMRs (Khalifa, 2013). But the questions remain, are incentives enough to increase use and build routines? Attewell (1992) defined complex organizational technologies as “technologies that, when first introduced, impose a substantial burden on would-be users in terms of the knowledge and motivation needed to use these technologies effectively” (p.5). Individual motivation to learn influences their decisions regarding the direction, focus, and level of effort that constitute their participation in any work-related initiative or task (Noe et al., 1986). Notboom (2014) suggest that knowledge and learning play important roles in the use of IT. Therefore, this research study hypothesizes that:

**H4: Motivation to learn will positively relate to physicians individual learning.**

## **Individual Learning**

Individual learning is imperative to the success of EHR use. Individual learning is key to performance for knowledge-intensive technology systems such as EHR (Esmaeilzadeh, Sambasivan, Kumar & Nezakhati, 2011). Paper charts have been part of practicing medicine for decades. Paper charts do not require a formal work system. Most physicians had their own process and procedure related to documenting paper charts. The introduction of EHR has clearly changed the way physicians conduct everyday patient related tasks. Not only does EHR changes the way hospitals do business and technology but creates a new workflow system for physicians. But, most physician consider EHRs to be challenging to use because of multiple of screens, options, and navigational aids (Ludwick, 2009). The complexity and usability problem associated with EHRs results in physicians having to allocate time and effort if they are to master them (Boonstra, 2010).

Physicians must learn how to incorporate EHR in their daily routines. Hospitals traditionally used paper to record patient records and to communicate with one another. EHR has caused a disruption in most work routines. Physicians have been challenged to learn a new system. Physicians have to learn how to use the EHR system effectively and efficiently which they see as a burden. The lack of technical skills leads the staff to regard EHR system as extremely complicated. Staff have a central role in the use of the EHRs, as they are who provide much of the information that the systems handle in their automated processes (Castillo, 2010). Many physicians, nurses and clinicians report that using EHRs will take more time for each patient than using paper as, in some situations, it might be more convenient and efficient to use paper records during the clinical encounter (Laerum, 2001). One of the major issues in the maximum utilization of the EHR is how best to

prepare the care delivery team to use EHR in a safe and effective way (Dastagir et al., 2012). If physicians are willing to learn how to use the EHR effectively and efficiently, this research theorizes that a physician individual learning will have a positive impact on EHR. Hence, this study hypothesizes:

**H5-H7: Physician individual learning will positively relate to routine use of EHR.**

### **Moderator**

Hospitals are typically categorized as high reliability organizations (HRO). HROs are referred to highly predictable and effective operations in the face of hazards that can harm hundreds or thousands of people at a time (Carroll & Rudolph, 2006). However, most recently health care has been challenged by variability of individual patients, incomplete evidence bases, rapidly evolving technologies, and shifting financial and regulatory climates (Weick, Sutcliffe & Obstfeld, 1999). Hospital must adjust promptly to rapid changes in order to stay competitive in their local market. Hospitals are faced with more complex, interdependent, unpredictable, and unforgiving technologies, whose frontline experts (such as physicians) know more about their work than do their administrators (Institute of Medicine, 2001).

Health care is becoming increasingly competitive. EHR allows patients to change patient easy. Physicians are challenge to constantly meet the needs of their customers. Service has become the focal point for the health care industry. The changing dynamic of the role of patient, new technology, evolving legislation changes and changes in the external regulatory environment have created turbulence in the hospital environment (Salyer, 1995).

### **Environmental Turbulence**

Environmental turbulence refers to the amount of change and complexity in the environment of a company (Hanvanich, Sivakumar & Hult, 2006). Environmental turbulence in hospitals environment could involve patient or technology changes. The changing role of patient and new technology are two of the biggest consequences of the new meaningful use guidelines. In today's fast changing complex technological environment with high uncertainty, success depends on developing new knowledge in order to keep up with technology advancement (Chen et al., 2005). Technology uncertainty increases when a technology changes rapidly or is new (Moriarty & Kosnik, 1989). EHR has made many changes in the health care delivery systems. EHR can help providers discover more effective treatment tactics that may reduce ineffective, redundant, and unnecessary tests and procedures that inconvenience the patient and the provider and increase costs (Kudyba & Temple, 2010). EHR can alleviate complexities in billing activities that can result in overbilling recipients (Asakura, Alto, Ordal, & Whitcomb, 2014). EHR can help enhance preemptive treatment to mitigate illnesses from developing into fully developed chronic diseases (Darcy, Lewis, Ormond, Clark, & Trafton, 2011).

Yet, the changes that technology brings forth require learning of many different processes. Processes are the fundamental to developing routines in a hospital environment. Physicians are dealing with how to prioritize competing interest: serving patient, adhering to meaningful use technology and finding time to learn new systems (McGinnis, Powers & Grossmann, 2011). Technology is a new concept for hospitals and there are multiple levels of change occurring in the environment. However, customers are one of the most unpredictable factors in a physician's environment. The rapid changes in health care has provided patient the opportunity to shop around for physicians. This means, that a patient

can switch doctors pretty quickly because their medical records are stored in the EHR system. Hence, turbulence reflects rapidly changing patient preferences, wide-ranging needs and wants, ongoing patient entry and exit from the marketplace, and constant emphasis on offering new services (Hult et al., 2004). Hence, this study hypothesizes:

**H8-H10: Environmental turbulence will negatively moderate the relationship between individual learning and routine use of EHR.**

## **CHAPTER IV**

### **METHODOLOGY**

Chapter four presents the solution approach to be used; i.e., the method and analyses to answer the research questions using the model discussed in the preceding section. This section begins with a description of the empirical survey design followed by how the sampling will be performed, and the specific analyses that will be executed. Description of the Research Design; Description of the Research Sample; Subjects; Description of the Research Instrumentation; Description of the Research Procedures; Design of the Study and Methodologic Assumptions.

#### **4.1 Methodology**

Every research method has advantages and disadvantages (McGrath, 1982). Did the researchers choose the most appropriate research method for the particular research question that they were investigating? Did they deal with the disadvantages of that method? If not, how do you think that those disadvantages may have affected the results? For example, did the researchers conduct their research on the internet, and if so did they address the limitations of this particular methodology (Skitka & Sargis, 2006)? Case



studies differ fundamentally from surveys in that the researcher generally has less apparent knowledge of what the variables of interest will be and how they will be measured (Gable, 1994).

This research study is cross-sectional design to survey physicians in US hospitals. A survey is a non-experimental, descriptive research method (Pather & Uys, 2008). Survey research, which is based on quantitative methodologies, draws on notions of positivism (Pather & Uys, 2008). Positivist or logical positivist research is based on the notion that research can be objective, that the researcher is independent and that the results are valid, reliable and generalizable (Pather & Uys, 2008). Surveys can be useful when a researcher wants to collect data on phenomena that cannot be directly observed (Boudreau, Gefen, & Straub, 2001). The survey approach refers to a group of methods which emphasize quantitative analysis, where data for many organizations are collected through methods such as mail questionnaires, telephone interviews, or from published statistics, and these data are analyzed using statistical techniques (Gable, 1994). However, often the survey approach provides only a "snapshot" of the situation at a certain point in time, yielding little information on the underlying meaning of the data (Gable, 1994). Moreover, some variables of interest to a researcher may not be measurable by this method (Gable, 1994).

A survey is a way of going from observations to theory validation (Newsted, Chin, Ngwenyama, & Lee, 1996). For a survey to uncover a causal relationship or provide descriptive statistics, it must contain all the right questions asked in the right way. Kaplan and Duchon (1998) suggested "the stripping of context [e.g. reduced 'representability' or model complexity through the use of a closed survey instrument] buys 'objectivity' and testability at the cost of a deeper understanding of what actually is occurring" (p. 572).

Survey research is inflexible to discoveries (relatively poorer 'discoverability') made during data collection (Gable, 1994). Traditional survey research usually serves as a methodology of verification rather than discovery. Hence, given the popularity of surveys as a data collection tool, it is incumbent upon researchers to apply stringent measures to ensure the validity and reliability of the research instrument and hence improve the quality of the results (Pather & Uys, 2008).

The data collection method is a single questionnaire which was pre-tested before being sent to the full sample set. This research study is cross-sectional design to survey physicians. A survey is a non-experimental, descriptive research method (Pather & Uys, 2008). Survey research, which is based on quantitative methodologies, draws on notions of positivism (Pather & Uys, 2008). Positivist or logical positivist research is based on the notion that research can be objective, that the researcher is independent and that the results are valid, reliable, and generalizable (Pather & Uys, 2008). Surveys can be useful when a researcher wants to collect data on phenomena that cannot be directly observed (Boudreau et al., 2001). The survey approach refers to a group of methods which emphasize quantitative analysis, where data for many organizations are collected through methods such as mail questionnaires, telephone interviews, or from published statistics, and these data are analyzed using statistical techniques (Gable, 1994).

#### **4.2 Survey Instrument**

Empirical research is effective at verifying models and relationships. There are a number of methods available to the researcher with the most common being interviews, mailings, electronic surveys, telephone surveys, and subject matter experts with surveys (postal, electronic, or telephone). This research will use an online survey to obtain responses to understand individual learning and routine use of EHR. We will use a third-

party provider to collect the data. I provided the provider an introduction page to introduce the survey purpose, guarantees anonymity, and provides contact information of the researcher. The survey will initially ask several screener questions to determine, if the recipient qualify for the purposes of this research. The screener questions will include the following question:

SC1	How often do you use the EHR system? Everyday 2-3 times a week Once a week Never
-----	--

I conducted a pretest prior to survey distribution. The proposed instrument will be pretested by local physicians. I asked two physicians for an hour debrief meeting. This will allow me to sit down with the physicians and discuss area of improvement or clarification related to the survey. Feedback from the pre-test will be used to revise the introduction and survey. The survey instrument and the introduction will be amended based on the feedback received to indicate the estimated time to complete, document the requirements for the survey respondent's eligibility, improve the clarity of measurement definitions, and standardize verb tenses. The development of the questionnaire from the literature and revising it based on feedback from the pre-test provide content validity. The final introduction and survey instrument are shown in Appendices IV respectively.

#### **4.3 Measurement Scale**

This research study used a 5-point Likert scale to assess physician's perceptions. Likert scales provide a range of responses to a statement or series of statements. Usually, there are 5 categories of response ranging from 5 = strongly agree to 1 = strongly disagree with a 3 = neutral type of response (Jamieson, 2004). A main advantage of a 5-point Likert

scale is that it is easy to interpret the data gathered because of the numbering assigned to each option, according to Simply Psychology. Also, as observations can range from "one" to "five" or "low" to "high," it also gives more scope than a simple yes/no format of questioning. A 5-point Likert scale is typically given to measure attitudes of a group of people. Whenever surveys are given, it is always advisable to make things as simple as possible for survey takers, and that is exactly what the 5-point Likert scale does. Available options are numbered from one to five or described on a scale "negative" through "neutral" and "positive." A survey taker may wish to answer "negative" regarding a question without implying that their opinion is strongly negative. The 5-point Likert scale gives the option to respond in a slightly negative way, allowing the opinion to be somewhat tempered.

Likert-type scales are useful when you are measuring latent constructs - that is, characteristics of people such as attitudes, feelings, opinions, etc (Trochim, 2006). Latent constructs are generally thought of as unobservable individual characteristics. The main advantage of Likert Scale questions is that they use a universal method of collecting data, which means it is easy to understand them. Working with quantitative data, it is easy to draw conclusions, reports, results and graphs from the responses. Furthermore, because Likert Scale questions use a scale, people are not forced to express an either-or opinion, rather allowing them to be neutral should they so choose. Once all responses have been received, it is very easy to analyze them. However, the problem with Likert Scale questions is that they are unidimensional. Because they only give a certain amount of choices, it would imply the space between each possibility is equidistant, which is not true. As a result, a true attitude is not actually measured. Researcher must realize that your previous questions will have influenced responses to any further questions that have been asked.

#### **4.4 Control Variable**

We use eleven control variables found in the literature that are divided into three groups for this research. These control variables serve two purposes. First, they can be used to describe the survey participants. Second, they will be used to explore the survey results to improve our understanding of the relationships in the model.

#### **4.5 Respondent Profile**

Five variables are identified to characterize the physician demographics. The capturing and reporting demographic data for the physician's help identify and categorize them which may lead to possible insights regarding the size, type of hospital, system, and working unit. Demographic data for a respondent includes their gender, age range, tenure, employment relationship, department, and hospital system (Bodur & Filiz, 2009). Physicians are very hard to recruit for survey completion. We will use Qualtrics to conduct the survey. For hard-to-reach groups, Qualtrics utilizes niche panels brought about through specialized recruitment campaigns. Hundreds of profiling attributes are included in our panels to guarantee accurate and detailed knowledge of every potential respondent.

#### **4.6 Sampling Plan**

This research recognizes the importance and criticality of the physician to understand EHR routinization. Therefore, the sample set for this empirical research is exclusively physicians to represent the individuals that are required to document patient visits through the use of EHR system. The study is constrained to US hospitals and does not include independent physician offices, family practices, or nursing homes for the purpose of controlling the sample.

#### **4.7 Unit of Analysis**

The unit analysis for this study are physicians. Health care is constantly changing in the wake of reform. Today, the tides of change are pushing the health-care system toward ever greater shared accountability among physicians, hospitals, and payers (Cochran, Kaplan, & Nessec, 2014). EHRs are hi-tech systems and, as such, include complex hardware and software (Boonstra, 2010). Most physicians consider EHRs to be challenging to use because of the multiplicity of screens, options and navigational aids (Ludwick, 2009). The complexity and usability problem associated with EHRs results in physicians having to allocate time and effort if they are to master them (Boonstra, 2010). Physicians have to learn how to use the EHR system effectively and efficiently which they see as a burden. The lack of technical skills leads the physician to regard EHR system as extremely complicated.

Physicians have a central role in the use of the EHRs, as they are who provide much of the information that the systems handle in their automated processes (Castillo, 2010). EHRs systems require a fair amount of user knowledge and aptitude, which can cause hardships for those who weren't trained to use the technology (Smith, 2010). There is a learning curve for physicians as it relates to EHR. Physicians also need to spend time and effort on learning how to use an EMR system. However, the demands and pressures of delivering office-based care may not afford them the time to learn the system (Simon, et al., 2007). Physicians are the most impacted group as relate to the introduction of the EHR system. Most physicians consider EHRs to be challenging to use because of the multiplicity of screens, options and navigational aids (Ludwick, 2009). The complexity and usability problem associated with EHRs results in physicians having to allocate time and effort if they are to master them (Boonstra, 2010). Physicians have to learn how to use the EHR

system effectively and efficiently which they see as a burden, while balancing the doctor-patient relationship.

#### **4.8 Sample Set**

This research recognizes the importance and criticality of physicians to deliver quality care to patient. Therefore, the sample set for this empirical research is exclusively involve physicians currently working in an US hospital. Of course, the study is constrained to the health-care industry and hospitals who are currently utilizing EHR system. We will specify that hospitals belong to system and non-systems should be selected for the purpose of obtaining a cross sample to improve the generality of the findings. Physicians are a relatively difficult group to study and most physician studies on workflows tend to employ small sample sizes (Vishwanath, Singh & Winkelstein & 2010). We used G Power to calculate the sample size for this study. The sample size was calculated as 120. The sampling method deals with issues of self-selection.

#### **4.9 Data Collection and Preparation**

A survey instrument was developed to test the hypothesis. The theoretical constructs were operationalized and measured using self-developed and pre-existing items. The survey will be pretested prior to sending to the third-party service to collect the data. I used local physicians to collect the pre-test data (approximately 30 physicians). Once the pretest data is collected, I analyzed and make any necessary changes to the survey. I sent the final survey to the selected third-party provider to code, check, and upload to their website. The third-party provider is responsible for gathering panel data. Physician respondents will be compensated for their participation in this study. Qualtrics respondents will receive an incentive based on the length of the survey, their specific panelist profile

and target acquisition difficulty. The specific type of rewards varies and may include cash, airline miles, gift cards, redeemable points, sweepstakes entrance and vouchers.

#### **4.10 Pretest**

Through analysis of the literature and reviewed existing measures to see if any constructs were appropriate. Based on the literature review, we found all pre-existing constructs except routine use of EHR and organization environmental turbulence. We developed survey items. Next schedule interviews with local healthcare professionals. Interviews were conducted with two individuals from Cleveland Clinic, one from MetroHealth, and one from St. Vincent. (ex. Based on feedback of the interviews: changed the wording to routine use of EHR to fit hospital terminology). Once feedback was gathered from participants. We conducted a pilot survey with 30 participants. Lastly, we reviewed the results and modified the survey (pre-existing items remained the same and routine use of EHR was modified).

#### **4.11 Analysis**

All analyses were carried out utilizing SMART PLS 2.0. SmartPLS is a component-based path modeling software application based on the partial least squares (PLS) method. Partial least squares using Smart PLS was used to analyze the data and test the hypotheses. PLS recognizes two models: the measurement model and the structural model. The measurement model consists of relationships among the conceptual factors and the measures underlying each construct (Halawi and McCarthy, 2008). It is assessed by examining individual item reliabilities, internal consistency and discriminant validity. It is necessary to test that the measurement model has a satisfactory level of validity and



reliability before testing for a significant relationship in the structural model (Fornell and Larcker, 1981).

We utilized PLS to assess our structural model. The structural model gives information as to how well the theoretical model predicts the hypothesized paths or relationships (Chin, 1998). It is estimated by the path coefficients and the size of the R-squared values. Smart PLS provides the squared multiple correlations (R-squared) for the endogenous construct in the model and the path coefficients. R-squared indicates the percentage of the variance of the constructs in the model. The path coefficients indicate the strengths of relationships between constructs (Chin, 1998). The values of the path coefficients and R-squared are shown.

#### *Confirmatory Factor Analysis*

Sound empirical research needs to demonstrate credibility and usability; this will be accomplished by a thorough analysis of the survey data (Flynn et al., 1994). We use factor analysis (Hatcher, 1994) as a guide for the necessary reliability and validity test. Factor analysis is a collection of methods used to examine how underlying constructs influence the responses on a number of measured variables (DeCoster, 1998). Factor analysis is used in data reduction to identify a small number of factors that explain most of the variance that is observed in a much larger number of manifest variables. Factor analysis attempts to identify the relationship between all variables included in the observed data. Factor analysis can also be used to generate hypotheses regarding causal mechanisms or to screen variables for subsequent analysis (DeCoster, 1998). Factor analysis can also help identify multi-collinearity prior to performing a linear regression analysis.

Factor analysis process begins with a large number of variables and then the researcher tries to reduce the interrelationships among the variables to a few number of clusters or factors (Hatcher, 1994). We learned in statistic class that measures that are highly correlated (positive or negative) are likely to influence by the same factors. Factor analysis finds relationships or natural connections where variables are maximally correlated with one another and minimally correlated with other variables, and then groups the variables accordingly (Hatcher, 1994). After this process has been done many times a pattern appears of relationships or factors that capture the essence of all of the data emerges (DeCoster, 1998). There are four known types of factor analysis, but for this discussion we exclude principle component and principle axis factoring. For this discussion purposes, I focused on exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). EFA attempts to discover the nature of the constructs influencing a set of responses (DeCoster, 1998). CFA tests whether a specified set of constructs is influencing responses in a predicted way.

### *Validity*

Instrument validation validity has been defined as the degree to which a test or measuring instrument actually measures what it purports to measure or how well a test or a meaning instrument fulfils its function (Anastasi & Urbina, 1997). There have been many different explanations of validity. Kaplan and Saccuzzo (2017) view validity as the evidence for inferences made about a test score. Further, McBurney and White (2007) view validity as an indication of accuracy in terms of the extent to which a research conclusion corresponds with reality. The foregoing suggests that validity hinges on the extent to which

meaningful and appropriate inferences or decisions are made on the basis of scores derived from the instrument used in a research.

I confirmed convergent and discriminant validity in this study. Straub (1989) indicated that the two main dimensions for testing the measurement model were convergent validity and discriminant validity. Convergent validity occurs when a high correlation exists, and this will confirm that the items are related to the construct. The average variance extracted (AVE) measures convergent validity. Fornell and Larcker (1981) recommended values higher than 0.50 to indicate convergent validity. Discriminant validity is evidence that a measure is not unduly related to other similar, yet distinct, constructs (Messick, 1989). Discriminant validity was assessed by comparing the square root of average variance extracted of one construct with correlations between this construct and another construct. Discriminant validity occurs when a low correlation exists, and this will confirm that the items are not related to the construct.

### *Reliability*

I tested the internal consistency of this study. Internal consistency is a technique to test whether or not done repeatedly would yield the same result each time (Strauss, 1998). Internal consistency defines the consistency of the results delivered in a test, ensuring that the various items measuring the different constructs deliver consistent scores (Shuttleworth, 2009). Internal consistency concludes if related questions (about the same concept) in survey are answered in the same way (Shuttleworth, 2009). Researchers usually want to measure constructs rather than particular items. There are several ways to measure internal consistency listed in the table below: Internal consistency is usually measured with Cronbach's alpha, a statistic calculated from the pairwise correlations between items (Strauss, 1998).

Researchers typically test measurement model to assess internal consistency. Internal consistency ranges between negative infinity and one. In statistics and research, internal consistency is typically a measure based on the correlations between different items on the same test (Kline, 1994). It measures whether several items that propose to measure the same general construct produce similar scores (Kline, 1994). Coefficient alpha will be negative whenever there is greater within-subject variability than between-subject variability. As Clark and Watson (1995) noted, the issue of internal consistency reliability assessment is complicated by the fact that “there are no longer any clear standards regarding what level is considered acceptable” for Cronbach’s alpha; past criteria have ranged from .80 or .90 alpha coefficients, down to .60 or .70 alphas. In summary, internal consistency is a measure of how well a test addresses different constructs and delivers reliable scores (Shuttleworth, 2009).

#### **4.12 Non-Response Bias**

Non-response bias is “the kind of bias that occurs when some subjects choose not to respond to particular questions and when the non-responders are different in some way (they are a non-random group) from those who do respond” (Groves, 2006). Not only do subjects often fail to “respond to a particular question,” but perhaps more detrimental to the sample, they may fail to respond at all. The former type of non-response is called "item non-response" and the latter is termed "unit non-response" (Van Den Berg, 2006, p. 1).

Non-response bias is problematic for two reasons. First, non-response bias can create bias in the sample. If the subjects who do not answer specific questions or fail to return the survey have certain characteristics—for example, if all non-respondents are female—this can affect the randomness of the sample (Van Den Berg, 2006). If the sample is biased and no longer random, then it lacks the potential to be representative of the larger

population from which the sample was drawn, thereby limiting the study's external validity. Second, samples need to be a certain size. If a sample is too small in proportion to the population or as required by the type of statistical test, the researcher will not have enough information from which to make a statistical inference about the population (Sivo, Saunders, Chang, & Jiang, 2006). After a review of IS literature, Pinsonneault and Kraemer (1993) reviewed IS research using questionnaires and identified five main problems; three of which, because of their relevance to this article, are identified here: 1) low response rates, 2) unsystematic/inadequate sampling procedures, and 3) single method designs (Sivo et al., 2006).

Not only does nonresponse bias a sample, but it can also lead to low power and inaccurate effect size estimation, particularly when the sample size turns out to be too low (Sivo et al., 2006). Shadish et al. (2002) classified both the condition of low power and inaccurate effect size estimation as threats to statistical conclusion validity. A chief cause of insufficient power in practice involves having an inadequate sample size (Shadish et al., 2002). In such cases, sampling error tends to be very high, and so the statistical conclusion validity of a study's inferences is weakened (Shadish et al., 2002). Sivo et al. (2006) concluded that low response rates could lead to sample bias, low power, and inaccurate effect size, and IS researchers should use estimation strategies designed to minimize nonresponse. There are a number of strategies to minimize nonresponses, such as randomly sampling from the target population only enough people to have sufficient power and accurately determine effect size and using Dillman's empirically supported Tailored Design Method (TDM) to minimize nonresponse (Sivo et al., 2006).

#### **4.13 Common Method Bias**

Since this study is based on data from a single survey, I want to ensure common method variance was not influencing outcomes. Common method biases arise from having a common rater, a common measurement context, a common item context, or from the characteristics of the items themselves (Podsakoff, MacKenzie, Lee & Podsakoff, 2003). Method biases are a problem because they are one of the main sources of measurement error. Measurement error threatens the validity of the conclusions about the relationships between measures and is widely recognized to have both a random and a systematic component (Bagozzi & Yi, 1991; Nunnally, 1978). Therefore, it is important to carefully evaluate the conditions under which the data are obtained to assess the extent to which method biases may be a problem.

Method biases are likely to be particularly powerful in studies in which the data for both the predictor and criterion variable are obtained from the same person in the same measurement context using the same item context and similar item characteristics (Podsakoff et al., 2003). Accordingly, I followed the recommendations of Conway and Lance (2010), who believe studies using single surveys should 1) provide a rationale that the method is appropriate for the topic at hand; 2) show the measures have construct validity; 3) show that items do not overlap in content; 4) explain how authors minimized potential common method issues. I conducted Harman single factor test to exaa for common method bias.

#### **4.14 Harman Single Factor Test**

All data are self-reported and collected through the same questionnaire during the same period of time with cross-sectional research design, common method variance, variance that is attributed to the measurement method rather than the constructs of interest,

may cause systematic measurement error and further bias the estimates of the true relationship among theoretical constructs. Method variance can either inflate or deflate observed relationships between constructs, thus leading to both Type I and Type II errors (Bagozzi & Yi, 1990; Doty & Gulick, 1998; Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). Harman's one-factor test and confirmatory factor analysis, post hoc statistical tests, were conducted to test the presence of common method effect. All the 9 variables were entered into an exploratory factor analysis, using unrotated principal components factor analysis, principal component analysis with varimax rotation, and principal axis analysis with varimax rotation to determine the number of factors that are necessary to account for the variance in the variables. If a substantial amount of common method variance is present, either (a) a single factor will emerge from the factor analysis, or (b) one general factor will account for the majority of the covariance among the variables (e.g., Andersson & Bateman, 1997; Krishnan, Martin & Noorderhaven, 2006; Podsakoff et al., 2003; Podsakoff & Organ, 1986). Moreover, all 9 variables were loaded on one factor to examine the fit of the confirmatory factor analysis model. If common method variance is largely responsible for the relationship among the variables, the one-factor CFA model should fit the data well (Korsgaard & Roberson, 1995; Mossholder, Bennett, Kemery & Wesolowski, 1998).

#### **4.15 Structured Equation Model (SEM)**

Structural equation modeling (SEM) is first applied by Bollen (1989) and Joreskog (1973). Later, PLS-SEM were developed by Ringle, Wende, and Will. PLS-SEM have more potential compared to SEM because there are less assumptions. SEM is defined by some scholars as a statistical technique for testing causal relations, using a combination of statistical data and qualitative causal assumptions (Hair, Ringle, & Sarstedt, 2011). Kaplan

(2000, p. 1) proposed, that “structural equation modeling can perhaps best be defined as a class of methodologies that seeks to represent hypotheses about the means, variances and covariances of observed data in terms of a smaller number of ‘structural’ parameters defined by a hypothesized underlying model”. Ideally, you could conclude that SEM is a diverse set of mathematical models, computer algorithms, and statistical methods that fit networks of constructs to data (Kaplan, 2007).

#### Structural equation modeling (SEM)

- is a comprehensive statistical approach to testing hypotheses about relations among observed and latent variables (Hoyle, 1995).
- is a methodology for representing, estimating, and testing a theoretical network of (mostly) linear relations between variables (Rigdon, 1998).
- tests hypothesized patterns of directional and nondirectional relationships among a set of observed (measured) and unobserved (latent) variables (MacCallum & Austin, 2000).

The growing interest in SEM techniques and recognition of their importance in IS research (Gefen, Straub, & Boudreau, 2000). SEM techniques such as LISREL1 and Partial Least Squares (PLS) are second generation data analysis techniques (Bagozzi & Fornell, 1982) that can be used to test the extent to which IS research meets recognized standards for high quality statistical analysis. SEM allows researchers to answer a set of interrelated research questions in a single, systematic, and comprehensive analysis by modeling the relationships among multiple independent and dependent constructs simultaneously (Gerbing & Anderson, 1988).



SEM techniques are based on multivariate statistical procedures, which are widely used by researchers in different disciplines (Karim & Meyer, 2014). SEM offers a conventional multivariate statistical analysis by accounting for measurement error and by comprehensively examining goodness-of-fit. The SEM technique has grown out of path and factor analysis. The method is preferred by the researcher because it estimates the multiple and interrelated dependence in a single analysis (Karim & Meyer, 2014). In this analysis, two types of variables are used endogenous variables and exogenous variables. Endogenous variables are equivalent to dependent variables and are equal to the independent variable. Structural equation modeling is also called casual modeling because it tests the proposed casual relationships (Lani, 2001). The following assumptions are assumed when utilizing SEM:

**Table IV: SEM Assumptions**

<b>Assumption</b>	<b>Description</b>
Multivariate normal distribution:	The maximum likelihood method is used and assumed for multivariate normal distribution. Small changes in multivariate normality can lead to a large difference in the chi-square test.
Linearity:	A linear relationship is assumed between endogenous and exogenous variables.
Outlier:	Data should be free of outliers. Outliers affect the model significance.
Sequence:	There should be a cause and effect relationship between endogenous and exogenous variables, and a cause has to occur before the event.
Non-spurious relationship:	Observed covariance must be true.
Model identification:	Equations must be greater than the estimated parameters or models should be over

	identified or exact identified. Under identified models are not considered.
Sample size:	Most of the researchers prefer a 200 to 400 sample size with 10 to 15 indicators. As a rule of thumb, that is 10 to 20 times as many cases as variables.
Uncorrelated error terms:	Error terms are assumed uncorrelated with other variable error terms.

(Lan, 2001)

### Advantages of SEM

SEM has potential advantages over linear regression models that make SEM a priori the methods of choice in analyzing path diagrams when these involve latent variables with multiple indicators. Latent variables are theoretical constructs that, prior to neuroscience techniques, could not be measured directly (such as beliefs, intentions, and feelings); they could only be measured indirectly through those characteristics we attribute to them. At least in classical measurement theory (Churchill, 1979), such latent variables should be based on relevant theory when they are expressed through measured variables like questionnaire scales. Not recognizing measurement error, the distinction between measures and the constructs being measured, leads to erroneous inference (Rigdon, 1994).

SEM involves the integration of the measurements (the so-called measurement model) and the hypothesized causal paths (the so-called structural model) into a simultaneous assessment (Gefen, Rigdon & Straub, 2011). Two current main approaches to structural equation modeling are covariance-based structural equation modeling (CBSEM) and partial least squares (PLS) path modeling. Both approaches start by first specifying a path model of latent variables and then assigning a set of indicators for each latent variable. After this step, these two approaches depart. In CBSEM, the researcher

traces the hypothesized factor loadings and regression paths to arrive in a set of equations describing the expected covariance structures in the data (Meehl & Waller, 2002). The set of equations is then used to derive a model implied covariance matrix and free parameters in the equations are estimated by minimizing the differences of the implied and observed covariance matrices.

SEM can analyze many stages of independent and dependent variables, including, in the case of CBSEM, the error terms, into one unified model. This one unified measurement and structural model is then estimated, either together as in CBSEM or iteratively as in PLS, and the results are presented as one unified model in which the estimates of both the measurement and the structural models are presented as a whole. This process allows a better estimation of both measurement and structural relationships in both CBSEM (Anderson & Gerbing, 1988) and PLS (Chin et al., 2008). This makes the estimates provided by SEM better than those produced by linear regression when the distribution assumptions hold. Even when the constructs of interest can be measured with limited ambiguity (such as price or weight), there are unique advantages to SEM over linear regression in that SEM allows the creation and estimation of models with multiple dependent variables and their interconnections at the same time. For a detailed discussion of this topic please refer to previous publications (Chin et al., 2008; Gefen et al., 2000).

#### **4.16 Partial Least Square**

All analyses were carried out utilizing SMART PLS 2.0. SmartPLS is a component-based path modeling software application based on the partial least squares (PLS) method. Partial least squares using Smart PLS was used to analyze the data and test the hypotheses. PLS recognizes two models: the measurement model and the structural model. The measurement model consists of relationships among the conceptual factors and

the measures underlying each construct (Halawi & McCarthy, 2008). It is assessed by examining individual item reliabilities, internal consistency and discriminant validity. It is necessary to test that the measurement model has a satisfactory level of validity and reliability before testing for a significant relationship in the structural model (Fornell & Larcker, 1981).

We utilized PLS to assess our structural model. The structural model gives information as to how well the theoretical model predicts the hypothesized paths or relationships (Chin, 1998). It is estimated by the path coefficients and the size of the R-squared values. Smart PLS provides the squared multiple correlations (R-squared) for the endogenous construct in the model and the path coefficients. R-squared indicates the percentage of the variance of the constructs in the model. The path coefficients indicate the strengths of relationships between constructs (Chin, 1998).

#### Stages and Steps in Calculating the Basic PLS-SEM Algorithm

##### Stage One: Iterative estimation of latent construct scores

- Step 1: Outer approximation of latent construct scores (the scores of Y1, Y2, and Y3 are computed based on the manifest variables' scores and the outer coefficients from Step 4).
- Step 2: Estimation of proxies for structural model relationships between latent constructs (P1 and P2).
- Step 3: Inner approximation of latent construct scores (based on scores for Y1, Y2, and Y3 from Step 1 and proxies for structural model relationships, P1 and P2, from Step 2).

- Step 4: Estimation of proxies for coefficients in the measurement models (the relationships between indicator variables and latent constructs with scores from Step 3; W1 to W7).

Stage Two: Final estimates of coefficients (outer weights and loadings, structural model relationships) are determined using the ordinary least squares method for each partial regression in the PLS-SEM model (Hair, Ringle & Sarstedt, 2011).

#### Comparison of PLS and SEM

On the basis of calculations and modeling, it can be perceived that PLS-SEM path modeling using SMARTPLS is appropriate to carry on the confirmatory factor analysis which is more reliable and valid. Based on the result section, the value of factor loadings/outer loadings, and average variance extracted (AVE) in PLS-SEM is better than CB-SEM even use the same data provided. To date, AVE with greater than 0.50 indicates the value for each factor capture more than half of variances or minimize the error variances. In this case, convergent and discriminant validity from PLS-SEM is success for fulfill the requirement needed. Thus, the researchers could carry on the future step which is structural model since the evaluation of measurement model is achieved. Confirmatory Factor Analysis (CFA) is the extension of exploratory factor analysis that can be obtained from SPSS since this method can be indicated by regression weight. Moreover, Hair et. al (2011) had suggest this method to be known as silver bullet since there are a lot of advantages compare to CB-SEM.

PLS-SEM is a method that offers vast potential for SEM researchers especially in the marketing and management information systems disciplines (Hair et al., 2011). PLS-SEM is, as the name implies, a more “regression-based” approach that minimizes the

residual variances of the endogenous constructs (Henseler, Ringle, & Sarstedt, 2012). CB-SEM is more robust with fewer identification issues, works with much smaller as well as much larger samples, and readily incorporates formative as well as reflective constructs. These advantages are inhibited by some disadvantages. One disadvantage is PLS-SEM's focus is on maximizing partial model structures (Hair et al., 2011). Specifically, the PLS-SEM algorithm first optimizes measurement model parameters and then, in a second step, estimates the path coefficients in the structural model. Researchers applying PLS-SEM first have to examine the measurement models' characteristics and deal with those that are unacceptable. Another issue that restricts the use of PLS-SEM for theory testing and confirmation is that there is no adequate global measure of goodness of model fit. PLS-SEM parameter estimates are not optimal regarding bias and consistency.

#### **4.17 Moderation-PLS**

Saunders (1956) coined the term moderator variable to indicate a continuous variable that influences the predictive effectiveness of the predictor variable. A multivariate, curvilinear regression equation involving cross-products is used in which the beta weights, instead of being constant, are linear functions of the moderator variable (Saunders, 1956, p. 301). Cohen and Cohen (1983) stated that "the term moderator variable has come into use in psychometric psychology to describe a variable . . . that interacts with another so as to enhance predictability of a criterion. Baron and Kenny (1986, p. 1174) defines moderation in general terms, a moderator is a qualitative (e.g., sex, race, class) or quantitative (e.g., level of reward) variable that affects the direction and/or strength of the relation between an independent or predictor variable and a dependent or criterion variable. Specifically, within a correlational analysis framework, a moderator is a third variable that affects the zero-order correlation between two other variables (Baron and Kenny, 1986).

In such usage, [the moderator variable] taken alone usually shows no consequential relationship with the criterion" (Baron et al., 1986). Baron and Kenny (1986) agreed with Cohen and Cohen (p. 1174), stating that "it is desirable that the moderator variable be uncorrelated with both the predictor and the criterion . . . to provide a clearly interpretable interaction term."

Baron and Kenny (1986) was trying to convey that there should be no linear relationship between  $t$  and  $y$  or  $t$  and  $x$ . The test variable must be related in some way to have any effect. James and Brett (1984), who defined a moderated relationship as one in which the relationship between  $x$  and  $y$  depends on the level of  $t$ , implying an  $x$  by  $t$  interaction. They also recommended minimal linear co-variation between the moderator and independent and dependent variables. MacKinnon (2012) defined a pure moderator as one that does interact with the independent variable to produce an effect but is not related linearly to the dependent variable. They pointed out that this requirement arose in the psychometric literature because if both the moderator and independent variable are related linearly to the dependent variable, then either variable can be considered the moderator (MacKinnon, 2012). Coulton and Chow (1992) pointed out that in non-experimental research the moderator and independent variable are often correlated. The common element in all of these definitions of moderators that distinguishes them from mediators is that the magnitude of the effect of the independent variable on the dependent variable differs significantly at different levels of the moderator variable (Carte et al., 2003). In the more familiar analysis of variance (ANOVA) terms, a basic moderator effect can be represented as an interaction between a focal independent variable and a factor that specifies the appropriate conditions for its operation (Baron and Kenny, 1986).

Moderation occurs when the effect of an exogenous construct on an endogenous construct depends on the values of another variable, which influences (i.e. moderates) the relationship. For example, in their analysis of the relationship between dynamic capabilities and organizational performance, Wilden et al. (2015) demonstrate that the performance effect is contingent on the competitive intensity faced by firms as well as the firm's organizational structure. Research has brought forward several approaches for estimating moderating effects in PLS-SEM, which Henseler and Fassott (2010) and Rigdon et al. (2010) review. Henseler and Fassott (2010) evaluate different approaches to moderation in PLS-SEM in terms of their applicability to reflective and formative measures, statistical power or predictive power. A key argument for employing PLS-SEM relates to the use of formative measurement models since PLS-SEM readily handles both reflective and formative measures. Technically and implicitly, researchers accept the underlying assumptions of the PLS-SEM method (e.g., predictor specification; Lohmöller 1989; Wold 1982), which allow for the possibility of formative measurement models.



## **CHAPTER V**

### **RESULTS**

The purpose of this quantitative study was to examine whether the predictors of individual learning will lead to routine use of electronic health records (EHR) system. The study was administered using a computer-delivered self-administered questionnaire hosted by Qualtrics. Previous chapters include this study's purpose, problem, significance, and hypotheses. The literature review supported the need for additional research addressing what can lead to routine use of EHR system. This research argues that EHR routinization is key to achieving the promised benefits of EHR implementations. In this research, EHR routinization is defined as the regular use of EHR systems by healthcare professionals, whereby the EHR system is no longer perceived as being new or out-of-the-ordinary and has become institutionalized. and chapter 4 detailed the research design, population, and data collection procedures. Chapter 5 contains a review of the data collected, the findings, and the results of the data analysis guided by the following research questions:

RQ1: Investigate individual learning impact on routine use of EHR.

RQ2: Investigate the moderating relationship of organization environmental turbulence between individual learning and routine use of EHR.

### **5.1 Data Collection**

We partnered with Qualtrics to conduct data collection. Potential respondents are sent an email invitation informing them that the survey is for research purposes only, how long the survey is expected to take and what incentives are available. Members may unsubscribe at any time. To avoid self-selection bias, the survey invitation does not include specific details about the contents of the survey. The cover letter and its survey instrument (Appendices V and VI respectively) were posted to Qualtrics website to solicit from their list of panel participants in November 2017. The first phase of the data collection process was dry run. Qualtrics collected 15 surveys to conduct face validity. The second phase, Qualtrics collected the other 147 surveys. The surveys were submitted to the researcher for validation. The data was checked for flatlining and other answering sequencing. The online survey was closed after a week.

### **5.2 Missing Data**

There were no surveys with missing data. Qualtrics project manager programmed the survey for force response. No surveys were submitted with missing data.

### **5.3 Respondent and Hospital Characteristics**

Thirteen questions in the survey were designed to capture data that characterizes and profiles the respondent, the type of hospital and a description of the physician work in patient care: i.e. the control and demographic data. The data was broken into demographics, physician, and EHR characteristics. Table 2 describes the demographics of the population. 59.3% of the respondents were male. Over 64.2% of the physicians have

tenure of more than 15 years. 61% percent of the physicians were over the age of 50. Most respondents characterized their practice as private practice. The respondent demographics was a diverse group of individuals. Most respondents had experience with inpatient and outpatient. Lastly, the respondent experience with the EHR system varied from one year to ten years.

#### **5.4 Non-Response Bias**

In data collection, there are two types of non-response: item and unit non-response. Item non-response occurs when certain questions in a survey are not answered by a respondent. Unit non-response takes place when a randomly sampled individual cannot be contacted or refuses to participate in a survey. The bias occurs when answers to questions differ among the observed and non-respondent items or units. There were no non-responses from the survey. Participant were self-selected into the survey. Qualtrics panel partners randomly select respondents for surveys where respondents are highly likely to qualify. Certain exclusions take place including category exclusions, participation frequency and so on. Each sample from the panel base is proportioned to the general population and then randomized before the survey is deployed.

#### **5.5 Common Method Bias**

Survey data is self-reported and collected through the same questionnaire during the same period of time with cross-sectional research design, common method variance, variance that is attributed to the measurement method rather than the constructs of interest, may cause systematic measurement error and further bias the estimates of the true relationship among theoretical constructs. Method variance can either inflate or deflate observed relationships between constructs, thus leading to both Type I and Type II errors

(Bagozzi & Yi, 1990; Doty & Gulick, 1998; Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). Harman's one-factor test and confirmatory factor analysis, post hoc statistical tests, were conducted to test the presence of common method effect. All the 11 variables were entered into an exploratory factor analysis, using unrotated principal components factor analysis, principal component analysis with varimax rotation, and principal axis analysis with varimax rotation to determine the number of factors that are necessary to account for the variance in the variables. If a substantial amount of common method variance is present, either (a) a single factor will emerge from the factor analysis, or (b) one general factor will account for the majority of the covariance among the variables (e.g., Aulakh & Gencturk, 2000; Podsakoff et al., 2003; Podsakoff & Organ, 1986; Steensma, Tihanyi, Lyles, & Dhanaraj, 2005). Moreover, all 11 variables were loaded on one factor to examine the fit of the confirmatory factor analysis model. If common method variance is largely responsible for the relationship among the variables, the one-factor CFA model should fit the data well (Korsgaard & Roberson, 1995; Mossholder, Bennett, Kemery, & Wesolowski, 1998).

The Harman single-factor test requires loading all the measures in a study into an exploratory factor analysis, with the assumption that the presence of CMV is indicated by the emergence of either a single factor or a general factor accounting for the majority of covariance among measures (Podsakoff et al. 2003, p. 889). Podsakoff et al. characterize the Harman single-factor test as a diagnostic technique that "actually does nothing to statistically control for (or partial out) method effects" (p. 889). Further, they argue that the emergence of multiple factors does not indicate the absence of CMV and recommend

against the use of this test. We found that no one variable accounted for a large amount of the variance.

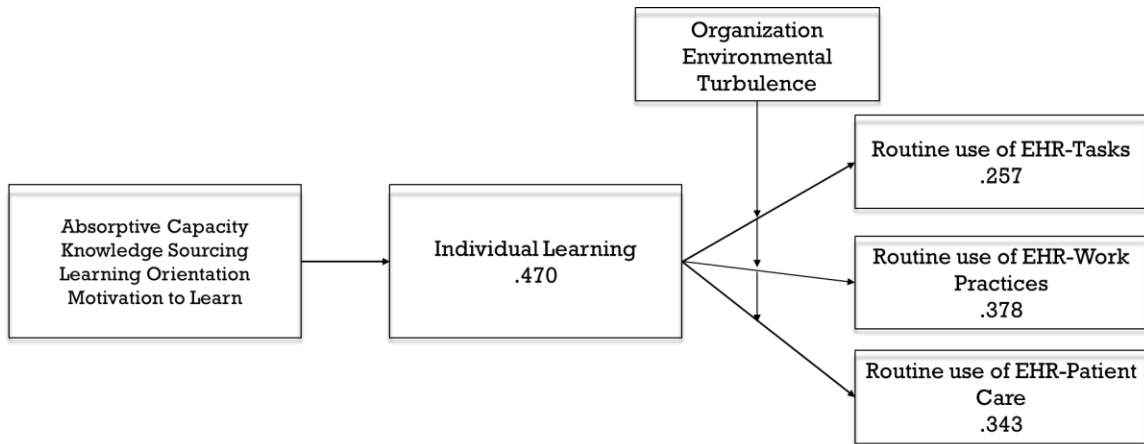
Harman's single factor test is one technique to identify common method variance. In EFA one examines the unrotated factor solution to determine the number of factors that are necessary to account for the variance in the variables. If a single factor emerges or one general factor will account for the majority of the covariance among the measures, then it is concluded that a substantial amount of common method variance is present. No one factor accounted for more than 50% of the variance. Refer to Table X for the actual analysis.

## **5.6 Analysis**

We tested the hypothesis using a PLS-SEM approach. PLS-SEM election is made on the grounds that this approach can test causal–predictive relationships between the latent variables simultaneously to support the weak theory (Jöreskog and Wold 1982). PLS-SEM enables researchers to examine the relationship with the complex variables, which is not possible using the covariance-based SEM approach or traditional regression (Hair et al. 2017; Latan & Ghozali 2015). Testing PLS will pass through two stages, namely the measurement model and the structural model. To complete our analysis, we applied a Partial Least Squares and structural equation modeling (SEM) tool (Smart-PLS 2.0 M3). SEM permits a simultaneous assessment of the structural component (path model) and measurement component (factor model) in the one model. Similar to LISREL and associated structural equation approaches, PLS presents the benefit of permitting the complete research model to be tested just once. All analyses were carried out utilizing SMART PLS 2.0.

SmartPLS is a component-based path modeling software application based on the partial least squares (PLS) method. Partial least squares using Smart PLS was used to analyze the data and test the hypotheses. PLS recognizes two models: the measurement model and the structural model. The measurement model consists of relationships among the conceptual factors and the measures underlying each construct (Halawi & McCarthy, 2008). It is assessed by examining individual item reliabilities, internal consistency and discriminant validity. It is necessary to test that the measurement model has a satisfactory level of validity and reliability before testing for a significant relationship in the structural model (Fornell & Larcker, 1981).

We utilized PLS to assess our structural model. The structural model gives information as to how well the theoretical model predicts the hypothesized paths or relationships (Chin, 1998). It is estimated by the path coefficients and the size of the R-squared values. Smart PLS provides the squared multiple correlations (R-squared) for the endogenous construct in the model and the path coefficients. R-squared indicates the percentage of the variance of the constructs in the model. The path coefficients indicate the strengths of relationships between constructs (Chin, 1998). The values of the path coefficients and R-squared are shown in Figure 6.



**Figure 6: PLS Results**

### 5.7 Results

Characteristics of our sample of physicians are consistent with those found in the broader United States physician population. Table V shows the characteristics of the respondents, revealing considerable diversity of practice types and sizes, as well as years of experience.

**Table V: Characteristics of Respondents and Practices (N=162)**

Characteristics	Response	%
Gender	Male	59.3
	Female	40.7
Age	Under 30	2.5
	30-39 years	22.8
	40-49 years	13.0
	50 years and older	61.7
Tenure	Less than 5 years	11.7
	5-10 years	14.2
	11-15 years	9.9
	over 15 years	64.2
How long have you used an EHR system?	under 1 year	2.5
	1-5 years	32.1
	5-10 years	39.5
	Over 10 years	25.9
Specialty Area	Internal Medicine	10.5

	OBGYN	4.9
	Pediatrics	18.5
	Family Medicine	14.8
	Other Medical Sub-specialty	11.1
	Surgery	4.3
	Surgical Sub-specialty	7.4
	Emergency	8.0
	Other	20.4
Are you currently employed by the hospital?	Yes (i.e. full-time employee)	43.8
	No (i.e. community physician)	56.2
What type of care do you provide?	Inpatient	14.8
	Outpatient	34.6
	Both	50.6
How would you characterize your practice?	Private Practice	40.1
	Academic Medicine	23.5
	Government	7.4
	Employee of System	17.3
	Community Physician	6.8
	Other	4.9

The means, standard deviations, and zero-order correlations of the study variables are shown in Table VI. The results of the correlation analysis are presented in Table VI and show that all correlations were statically significant.

**Table VI: Latent Variable Correlations**

Constructs	Mean	SD	AB	IL	KS	LO	MOT	R-T	R-WP	R-PC
<b>Absorptive Capacity</b>	2.1728	.75092	1.00							
<b>Individual Learning</b>	2.0667	.67096	.534**	1.00						
<b>Knowledge Sourcing</b>	2.6975	.86756	.211**	.393**	1.00					
<b>Learning Orientation</b>	2.9491	1.0644	.330**	.486**	.518**	1.00				



<b>Motivation Learning</b>	2.6199	.91247	.296**	.517**	.584**	.745**	1.00			
<b>Routine-Work Practice</b>	2.2753	.83197	.248**	.391**	-.011	.038	.209**	1.00		
<b>Routine- Tasks</b>	2.0159	.56608	.321**	.486**	.251**	.203**	.308**	.506**	1.00	
<b>Routine –Patient</b>	2.5580	.65954	.284**	.444**	.178*	.167*	.246**	.516**	.492**	1.00
<b>Environmental Turbulence</b>	2.4213	.73482	-.352**	-.401**	-.0221	-.0824	-0.0837	-.416**	-.393**	-.435**

\*p<.05 \*\*p<.01

Our second step in the analysis was to measure the reliability. The main reason reliability matters are that a measure that is not reliable cannot be valid (Shuttleworth, 2009). Reliability is the prerequisite to validity. Reliability measures accuracy and refers to the extent to which a scale produces consistent results, if the measurements are repeated a number of times (Kline, 2015). Reliability measures the degree to which the set of indicators of a latent variable is internally consistent in their measurements (Kline, 2015). Internal consistency reliability was assessed using composite reliability scores reported in the software output. As shown in Table VII, the value of the composite reliability of the different latent variables ranged from 0.70 to 0.96. These values exceeded the recommended acceptable limit of 0.70, indicating reliability (Chin, 1998).

Another measure to assess reliability and consistency of the entire scale is Cronbach's Alpha. Internal consistency is usually measured with Cronbach's alpha, a statistic calculated from the pairwise correlations between items (Strauss, 1998). Cronbach's Alpha can also be used to quantify unidimensionality, which means that a set of measured indicators have only one underlying construct (Chin, 1998). Table VII shows

the values of Cronbach's Alpha, which range from .60 to .95 for the constructs. These values exceeded the threshold of 0.60 to indicate reliability (Hair, 2011). Validity is the extent to which a scale or set of measures accurately represents the concept. Straub (1989) indicated that the two main dimensions for testing the measurement model were convergent validity and discriminant validity. Convergent validity occurs when a high correlation exists, and this will confirm that the items are related to the construct. The average variance extracted (AVE) is measures convergent validity. Fornell and Larcker (1981) recommended values higher than 0.50 to indicate convergent validity. Table VII shows the average variance extracted for each latent variable. The values were greater than the .50 threshold indicating convergent validity.

**Table VII: Convergent Validity**

<b>Constructs</b>	<b>AVE</b>	<b>Composite Reliability</b>	<b>R-Square</b>	<b>Cronbach Alpha</b>
Absorptive Capacity	.5834	.8459		.7645
Individual Learning	.4967	.8305	.470	.7462
Knowledge Sourcing	.5415	.8252		.7286
Learning Orientation	.7990	.9408		.9163
Motivation Learning	.6219	.9198		.8978
Routine-Work Practice	.6539	.8830	.343	.8231
Routine- Tasks	.4152	.7810	.257	.6974
Routine –Patient	.6266	.8673	.378	.8018

Discriminant validity is evidence that a measure is not unduly related to other similar, yet distinct, constructs (Messick, 1989). Discriminant validity was assessed by comparing the square root of average variance extracted of one construct with correlations between this construct and another construct. Discriminant validity occurs when a low correlation exists, and this will confirm that the items are not related to the construct. In

Table VIII, diagonal elements are square root of the variance shared between the constructs and their measurements. The off-diagonal elements are the correlations among constructs. For discriminant validity, diagonal elements should be larger than off-diagonal elements (Fornell and Larcker, 1981), which is the case as shown in Table VIII.

**Table VIII: Square Root**

<b>Constructs</b>	<b>Square Root</b>	<b>AB</b>	<b>IL</b>	<b>KS</b>	<b>LO</b>	<b>MOT</b>	<b>R-T</b>	<b>R-WP</b>
Individual Learning	.7509	.534**						
Knowledge Sourcing	.6447	.211**	.393**					
Learning Orientation	.7302	.330**	.486**	.518**				
Motivation Learning	.7063	.296**	.517**	.584**	.745**			
Routine-Work Practice	.6872	.248**	.391**	-.011	.038	.209**		
Routine-Tasks	.7674	.321**	.486**	.251**	.203**	.308**	.506**	
Routine – Patient	.7841	.284**	.444**	.178*	.167*	.246**	.516**	.492**

The test of significance of all paths were done using the bootstrap re-sampling procedure with 200 re-samples. The test statistic indicates if the relationship is statistically different than zero. The t values need to be significant to support the hypothesized paths (1.96 or 2.56 for alpha level of 0.05 or 0.001). The bootstrapping results were applied to each of the hypotheses with the results of the hypotheses testing. All hypothesis was reported significant based on the path coefficients (Table IX).

**Table IX: Summary of Hypothesis Testing**

Results of Hypotheses	Statistical Significance	Path Coefficient
Direct Effect		
Absorptive Capacity ----Individual Learning	Significant	.429**
Knowledge Sourcing ---Individual Learning	Significant	.112**
Learning Orientation ---Individual Learning	Significant	.087*
Motivation to Learn ----Individual Learning	Significant	.264**
Environmental Turbulence	Significant	-.272**
Individual Learning ---Routine use of EHR-Task	Significant	.531**
Individual Learning ---Routine use of EHR-Patient Care	Significant	.516**
Individual Learning ---Routine use of EHR-Work Practice	Significant	.519**
Moderator		
Environmental Turbulence – Tasks	Significant	-.259**
Environmental Turbulence – Patient Care	Significant	-.312**
Environmental Turbulence- Work Practice	Significant	-.209**

**\*p<.05 \*\*p<.01**

Harman’s one-factor test and confirmatory factor analysis, post hoc statistical tests, were conducted to test the presence of common method effect. All the 9 variables were entered into an exploratory factor analysis, using unrotated principal components factor analysis, principal component analysis with varimax rotation, and principal axis analysis with varimax rotation to determine the number of factors that are necessary to account for the variance in the variables. Common method variance is not present in the model and the results are present in Table X.

**Table X: Harmon Single Factor Test**

Total Variance Explained						
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	
1	11.728	24.953	24.953	11.728	24.953	24.953
2	5.565	11.840	36.793			
3	2.457	5.227	42.020			
4	2.104	4.476	46.496			
5	2.049	4.360	50.856			
6	1.739	3.699	54.555			
7	1.521	3.236	57.791			
8	1.319	2.807	60.598			
9	1.259	2.678	63.276			
10	1.223	2.601	65.878			
11	1.073	2.282	68.160			
12	1.025	2.180	70.340			
13	.967	2.058	72.399			
14	.841	1.789	74.188			
15	.801	1.705	75.892			
16	.738	1.570	77.462			
17	.702	1.494	78.956			
18	.659	1.402	80.358			
19	.621	1.322	81.680			
20	.598	1.273	82.953			
21	.574	1.221	84.174			
22	.547	1.163	85.337			
23	.531	1.129	86.467			
24	.509	1.083	87.549			
25	.480	1.021	88.570			
26	.464	.987	89.557			
27	.401	.852	90.409			
28	.376	.800	91.209			
29	.364	.775	91.984			
30	.347	.739	92.723			
31	.329	.701	93.424			
32	.312	.664	94.088			
33	.291	.620	94.707			
34	.273	.580	95.288			
35	.253	.538	95.826			
36	.239	.508	96.334			
37	.225	.480	96.813			

38	.200	.425	97.238			
39	.186	.396	97.634			
40	.178	.380	98.013			
41	.174	.369	98.383			
42	.167	.355	98.738			
43	.152	.323	99.061			
44	.133	.282	99.343			
45	.116	.247	99.590			
46	.109	.233	99.823			
47	.083	.177	100.000			

Extraction Method: Principal Component Analysis.

## 5.8 Moderation

Moderation describes a situation in which the relationship between two constructs is not constant but depends on the values of a third variable, referred to as a moderator variable (Hair, 2017). To contrast the hypotheses and analyze the moderating effect of organization environmental turbulence, we utilized PLS structural equations. This method is the most suitable to approach the stated research questions, owing to several reasons:

- Its predictive nature (Hair, Sarstedt, Hopkins, & Kuppelwieser, 2014; Sarstedt, et al., 2014);
- It allows observing different causal relations (Astrachan, Patel, & Wanzenried, 2014; Jöreskog and Wold, 1982); and,
- because it is less demanding in relation to the minimum sample size (Henseler, Ringle, & Sarstedt, 2015).

We used the two-stage approach in Smart PLS to test the interactions. This approach uses the latent variable scores of the latent predictor and latent moderator variable from the main effects model (without the interaction term). These latent variable scores are saved and used to calculate the product indicator for the second stage analysis that involves

the interaction term in addition to the predictor and moderator variable. We also used Interaction software to graph the interaction effect. Interaction software program specifically designed to draw and analyze statistical interactions.

## **5.9 Hypothesis discussion**

This section discusses the analysis of each research hypothesis.

### **Hypothesis 1:**

Hypothesis 1 proposes that absorptive capacity is positively related to physician individual learning. We test the relationship between the absorptive capacity and individual learning. PLS analysis was used to test if absorptive capacity significantly predicted a physician's individual learning (Table 6: Summary of Hypothesis Testing). Absorptive capacity significantly predicted physician's individual learning ( $\beta = .429$ ,  $p < .001$ ). This suggests that a physician's mental representation and ability to acquire new knowledge by relating it to existing knowledge signifies a physician propensity to learn. Hypothesis 1 is supported.

### **Hypothesis 2:**

Hypothesis 2 proposes that knowledge sourcing is positively related to physician individual learning. We test the relationship between the knowledge sourcing and individual learning. PLS analysis was used to test if knowledge sourcing significantly predicted a physician's individual learning (Table 6: Summary of Hypothesis Testing). Knowledge sourcing significantly predicted physician's individual learning ( $\beta = .112$ ,  $p < .001$ ). This suggests that a physician's intentional efforts to locate and access others' expertise, experience, and viewpoints will precede a physician inclination to learn. Hypothesis 2 is supported.

### **Hypothesis 3:**

Hypothesis 3 proposes that learning orientation is positively related to physician individual learning. We test the relationship between the learning orientation and individual learning. PLS analysis was used to test if learning orientation significantly predicted a physician's individual learning (Table 6: Summary of Hypothesis Testing). Learning orientation significantly predicted physician's individual learning ( $\beta = .087$ ,  $p < .005$ ). This suggests that a physician's desire to improve competence by acquiring new skills and overcoming challenges will lead to physician disposition to learn. Hypothesis 3 is supported.

#### **Hypothesis 4:**

Hypothesis 4 proposes that motivation to learn is positively related to physician individual learning. We test the relationship between the motivation to learn and individual learning. PLS analysis was used to test if motivation to learn significantly predicted a physician's individual learning (Table 6: Summary of Hypothesis Testing). Motivation to learn significantly predicted physician's individual learning ( $\beta = .264$ ,  $p < .001$ ). This suggests that a physician's desires to participate in, and learn from, a training activity will lead to a physician preference to learn. Hypothesis 4 is supported.

#### **Hypothesis 5**

Hypothesis 5 proposes that physician individual learning will positively relate to routine use of EHR tasks. We test the relationship between the individual learning and routine use of EHR tasks. PLS analysis was used to test if individual learning significantly predicted routine use of EHR tasks (Table 6: Summary of Hypothesis Testing). Individual learning significantly predicted routine use of EHR tasks ( $\beta = .531$ ,  $p < .001$ ). This suggests that physician's individual learning can lead to routine use of EHR tasks. Hypothesis 5 is supported.



### **Hypothesis 6**

Hypothesis 6 proposes that physician individual learning will positively relate to routine use of EHR work practice. We test the relationship between the individual learning and routine use of EHR work practice. PLS analysis was used to test if individual learning significantly predicted routine use of EHR work practice (Table 6: Summary of Hypothesis Testing). Individual learning significantly predicted routine use of EHR work practice ( $\beta = .531, p < .001$ ). This suggests that physician's individual learning can lead to routine use of EHR work practice. Hypothesis 6 is supported.

### **Hypothesis 7**

Hypothesis 7 proposes that physician individual learning will positively relate to routine use of EHR patient care. We test the relationship between the individual learning and routine use of EHR patient care. PLS analysis was used to test if individual learning significantly predicted routine use of EHR patient care (Table 6: Summary of Hypothesis Testing). Individual learning significantly predicted routine use of EHR patient care ( $\beta = .531, p < .001$ ). This suggests that physician's individual learning can establish routine use of the EHR system to complete patient care. Hypothesis 7 is supported.

### *Moderation Hypotheses*

### **Hypothesis 8**

Hypothesis 8 proposes that organization environmental turbulence moderates the relationship between physician individual learning and routine use of EHR tasks. We tested the interaction relationship between the individual learning and routine use of EHR tasks. PLS analysis was used to test if organization environmental turbulence negatively moderates the relationship between individual learning significant and routine use of EHR tasks (Table 6: Summary of Hypothesis Testing). Organization environmental turbulence

negatively moderated the relationship between individual learning significant and routine use of EHR tasks ( $\beta = -2.59, p < .001$ ). This suggests that the higher the organization environmental turbulence, the less likely that physician's individual learning will lead to routine use of EHR tasks. Hypothesis 8 is supported.

These variables accounted for a significant amount of variance in routine use of EHR-tasks,  $R^2 = .1550, F(3, 158) = 9.664, p < .001$ . To avoid potentially problematic high multicollinearity with the interaction term, the variables were centered and an interaction term between individual learning and organization environmental turbulences was created (Aiken & West, 1991). Next, we looked at the change in  $\Delta R^2 = .00163, p = .001, b = -0.0588, t(158) = 1.27, p < .01$ . Examination of the interaction plot showed an enhancing effect that when organization environmental turbulence is higher more individual learning is needed to establish routine use of EHR-tasks.

### **Hypothesis 9**

Hypothesis 9 proposes that organization environmental turbulence moderates the relationship between physician individual learning and routine use of EHR work practice. We tested the interaction relationship between the individual learning and routine use of EHR work practice. PLS analysis was used to test if organization environmental turbulence negatively moderates the relationship between individual learning significant and routine use of EHR work practice (Table 6: Summary of Hypothesis Testing). Organization environmental turbulence negatively moderated the relationship between individual learning significant and routine use of EHR work practice ( $\beta = -3.12, p < .001$ ). This suggests that the higher the organization environmental turbulence, the less likely that physician's individual learning will follow routine use of EHR work practice. Hypothesis 9 is supported.

These variables accounted for a significant amount of variance in routine use of EHR-work practice,  $R_2=.242$ ,  $F(3, 158) = 16.86$ ,  $p<.001$ . To avoid potentially problematic high multicollinearity with the interaction term, the variables were centered and an interaction term between individual learning and organization environmental turbulences was created (Aiken & West, 1991). Next, we looked at the change in  $\Delta R_2 = .006$ ,  $p = .001$ ,  $b = .1659$ ,  $t(158) = 5.546$ ,  $p < .01$ . Examination of the interaction plot showed an enhancing effect that when organization environmental turbulence is higher less individual learning is needed to establish routine use of EHR-work practice.

### **Hypothesis 10**

Hypothesis 10 proposes that organization environmental turbulence moderates the relationship between physician individual learning and routine use of EHR patient care. We tested the interaction relationship between the individual learning and routine use of EHR patient care. PLS analysis was used to test if organization environmental turbulence negatively moderates the relationship between individual learning significant and routine use of EHR patient care (Table 6: Summary of Hypothesis Testing). Organization environmental turbulence negatively moderated the relationship between individual learning significant and routine use of EHR patient care ( $\beta = -3.12$ ,  $p<.001$ ). This suggests that the higher the organization environmental turbulence, the less likely that physician's individual learning will transition to routine use of EHR patient care. Hypothesis 10 is supported.

These variables accounted for a significant amount of variance in routine use of EHR-patient care,  $R_2=.2144$ ,  $F(3, 158) = 14.377$ ,  $p<.001$ . To avoid potentially problematic high multicollinearity with the interaction term, the variables were centered and an interaction term between individual learning and organization environmental turbulences

was created (Aiken & West, 1991). Next, we looked at the change in  $\Delta R^2 = .004$ ,  $p = .001$ ,  $b = -.1089$ ,  $t(158) = 3.317$ ,  $p < .01$ . Examination of the interaction plot showed an enhancing effect that when organization environmental turbulence is higher more individual learning is needed to establish routine use of EHR-patient care.

### **5.10 Control Variable Analyses**

This section provides a thorough analysis of all 3 control variables to identify any influence on the model that may exist; these variables were related to physician demographics: gender, age, tenure and system experience. The healthcare literature suggests that the selected characteristics of a physician may have some impact on the use of the EHR system in the hospital environment.

#### *Physician Demographics*

##### Gender

The respondents were asked to identify themselves as male or female. There were more male than female respondents. The physician community has historically been dominated by males so there was no surprise that we had more male respondents. Hence, the percentage for male respondents were 59.3% and female was 40.7%. There was an 18.6 percent difference between male and female physicians. We found that gender has no significant impact on the findings.

##### Age

All respondents were asked to identify themselves into one of four age ranges. We define “Younger” respondents as those with ages up to 39 years, and “Older” respondents as those with ages above 40. Most of our respondents were in 50 years and older age range. Over 60% of the respondents were in the 50 years and older age range. The next age range

was 30-39 years, which represented 22.8%. We found that gender has no significant impact on the findings.

#### Tenure

All respondents were asked to identify the number of years as a physician. We define a respondent as having a low number of years if they have worked at that company for less than 10 years, and a high number of years if they have worked at that company for 10 or more years. Most of the respondents had over 15 years of experience in the profession, which represented 64.2% of the population. We found that gender has no significant impact on the findings.

#### System Experience

All respondents were asked to identify the number of years' experience in working with EHR system in one of four ranges of years. We define a low number of years' experience as less than 10 years, and a high number of years' experience as 10 or more years. Most respondents had between 5-10 years of experience with EHR system, which represented 39.5% of the population. We found that gender has no significant impact on the findings.

## **CHAPTER VI**

### **DISCUSSION AND IMPLICATIONS**

This chapter presents a detailed discussion of the various constructs and their interrelationships. The first section discusses the overall results of this empirical research and the second section presents a detailed discussion of each of the constructs.

The data from this empirical study exhibits excellent measurement characteristics evidenced by consistently acceptable levels of reliability, validity, and unidimensionality. These acceptable levels indicate that the respondents believe the model's factors to be important and relevant to the process of individual learning and routine use of EHR. The results showed that the respondents represented a wide range of physicians, which speaks to the generalizability of the findings. The sample size also contributes to the statistical significance of the findings. An analysis of each control variable found no significant change in the findings, which can be found in Chapter 5. Ten hypotheses were proposed for this research and statistically tested. Table XI summarizes the model results.

**Table XI: Model Results**

Hypothesized Relationship	Coefficient	P-value	Supported
H1: AB to IN	.429**	<.01	Yes
H2: KS to IN	.112**	<.01	Yes
H3: LO to IN	.087*	<.05	Yes
H4: ML to IN	.264**	<.01	Yes
H5: IN to R-Tasks	.531**	<.01	Yes
H6: IN to R-WP	.516**	<.01	Yes
H7: IN to R-PC	.519**	<.01	Yes
H8: IN to ET to R-Tasks	-.259**	<.01	Yes
H9: IN to ET to R-WP	-.312**	<.01	Yes
H10: IN to ET to R-PC	-.209**	<.01	Yes

## 6.1 Discussion

Physicians' complaints about the EHR center around the disruptions of their daily responsibilities. The disruption caused by new technologies can lead to productivity losses or even a higher level of errors (Embi et al., 2004; Weir et al., 2003). Currently, there are no incentives to support physicians creating routines while using the EHR system. There are a variety of problems, the routine is under-resourced or poorly coordinated; the technology is inadequate; the new routine conflicts with other, more established or critical routines; key actors lack the necessary autonomy; or leaders create a weak or inappropriate

framing for the routine and fail to invest in team training (Greenhalgh, 2008). The negative impact of the disruption usually fosters resistance among physicians in several ways, such as 1) physicians use non-standard ways to complete EHR tasks; 2) physicians circumvent the EHR to complete their work 3) physicians determine that limited EHR systems use is sufficient; and 4) physicians abandon or bypass EHR system completely.

This study recognizes that routinization occurs at the individual level. Technological change affects all incumbents due to the high costs and uncertainty associated with technological discontinuities. However, despite these challenges, the process of internal learning is one of the most effective ways for a firm to upgrade and build competences (Cohen & Levinthal, 2000). Hence, the literature suggests that individual learning plays a key role in the development of routines. Routinization only occurs when individuals establish routine use of the system. For this reason, the dependent variable for this study is called Routine Use of EHR system. Based on the work of Saga and Zmud (1992), this research study defines EHR routinization as the regular and standard use of EHR systems by health care professionals, whereby the EHR system is no longer perceived as being new or out-of-the-ordinary. The health-care industry is under tremendous pressure to deliver the best services to patients. Routines are of particular importance in high reliability settings like hospitals because there is little room for error (Tucker et al., 2007; Weick & Sutcliffe, 2006).

Research has shown that it is difficult to achieve routinization in health care for the following reasons:

- Physicians don't know how to use the system (Ash, Berg & Coiera, 2004).
- Physicians don't appreciate the need to use EHR in standardized ways (Walsh, 2004).



- Most physicians simply don't believe they have time to learn an entirely new system and use it effectively, immediately (Boonstra, 2010).
- Most physicians consider EHRs to be challenging to use because of the multiplicity of screens, options and navigational aids (Ludwick, 2009).
- Physicians also need to spend time and effort on learning how to use an EHR system (Miller & Sims, 2004).

The demand and pressures of delivering office-based care may not afford them the time to learn the system. Physicians continue to argue that EHR interfere with doctor patient relationship. Many physicians reported that using EHRs will take more time for each patient than using paper as, in some situations, it might be more convenient and efficient to use paper records during the clinical encounter and document the visit later. In some instances, physicians sometime stop using EHRs because hunting for menus and buttons disrupts the clinical encounter. Most patients value the time that physicians spend with them and EHR creates a disruption that is unwarranted by the physician themselves. EHRs increases the average screen gaze time of physicians from 25% to 55% of the consultancy session, inevitably resulting in less eye-contact and less conversation with the patient (Patel & Ozok, 2008).

## **6.2 Theoretical Constructs**

### **Individual Learning**

This research focused on physician individual learning to understand how routines use of the EHR system is established in hospital environment. In essence, the finding suggests that individual learning interacts to influence routine use of EHR. Specially, we found that absorptive capacity, learning orientation, knowledge sourcing, and motivation to learn were significantly related to individual learning. This finding suggests that

individual learning does lead to routine use of the EHR system. Literature suggests that individual learning and adaptation in an organizational context plays an important role in developing routines and fostering continuous learning in the health-care environment. Individual learning is particularly interesting among physicians because physicians referred to as professionals, professional autonomy is typically granted. This means that physicians have control over the conditions, processes, procedures, or content of their work which will not be possessed or evaluated by others. Physicians must possess a willingness to learn to create routines. Individual learning is crucial to performance for knowledge-intensive activities such as routinization.

In this study individual learning is a formative construct, we determine that individual learning is constructed by absorptive capacity, learning orientation, knowledge sourcing, and motivation to learn. A formative model posits a composite variable that summarizes the common variation in a collection of indicators (MacCallum & Browne, 1993). A composite variable is considered to be composed of independent, albeit correlated, variables. The causal action flows from the independent variables to the composite variable. Formative constructs work distinctly different: changes in the formative measures cause changes in the underlying construct (Jarvis et al. 2003). Each measure captures differing aspects of individual learning, and as a result, this operationalization of the construct is formative.

### **Absorptive Capacity**

Absorptive capacity supports physician individual learning by forming new conceptions based on prior knowledge. Physicians ability to acquire and apply new knowledge is based on the previous knowledge he or she has accumulated. Absorptive

capacity does play a significant role in the knowledge-transfer process and supports individual learning. Absorptive capacity is also seen as a broad set of organization member skills needed to deal with the tacit component of transferred knowledge and needed to modify this imported knowledge. Individual absorptive capacity means an individual can value, assimilate, and apply new knowledge. Physicians typically have the proper medical knowledge to apply to the EHR systems, while lacking the computer skills needed to efficiently use the system. We have seen resistance among older physicians whereas younger physicians have embraced new technology. However, physicians have a tremendous responsibility and their ultimate job is to save lives or obtain better outcomes for his or her patients. A physician's absorptive capacity can potentially be less based on all the tasks and responsibilities related to patient care.

The finding suggests that absorptive capacity influences individual learning. Absorptive capacity has the strongest relationship with individual learning. In Chapter 5 Table 4, absorptive capacity has the strongest correlation to individual learning at .5639. A plausible reason for these results may be that prior knowledge of the respondents were high because most of them had prior knowledge or experience related to technology. For example, prior knowledge of knowing how to use a computer can aid in a physician's ability to learn more about the EHR system. Another possible reason for these results is that physicians already have the medical knowledge that can be applied to the EHR system. We can posit that physicians already have the medical stored in memory, which leads to acquiring new related concepts and application in a different context.

EHR requires most physicians to acquire new knowledge. EHRs systems require a fair amount of user knowledge and aptitude, which can cause hardships for those who

weren't trained to use the technology. Trends have shown that some older physicians tend to retire from the practice early to avoid learning how to use the system (Lin, Lin & Roan, 2012). Younger physicians welcome the new change. The biggest complaint for older physicians and reasons for resistance, relates to the doctor patient relationship. Patient care has historically been the focus for most physicians. Anything that interrupts patient care is considered an opposition. Many physicians report that using EHRs will take more time for each patient than using paper as, in some situations, it might be more convenient and efficient to use paper records during the clinical encounter. If using EHRs, physicians may have to stop halfway through a consultancy in order to enter information on patients or type a prescription, and this will disrupt the flow.

### **Knowledge Sourcing**

Knowledge sourcing refers to a physician's intentions and effort to access others' expertise, experience and viewpoints. Knowledge sourcing involves multiple individuals; in essence one person is seeking knowledge from another to complete a task or gain insight. Knowledge sourcing is particularly important in a work environment where teaming and integrated work must take place. Knowledge sourcing can occur in multiple forms: internet, training documents or other individuals. Knowledge sourcing in healthcare can take place between a physician and nurse or physician and clinicians. Nurses are great sources of information for physicians regarding to EHR questions.

The finding suggests that knowledge sourcing influences individual learning. The results support previous findings on the role of seeking knowledge from others. In Chapter 5 Table 4, knowledge sourcing has the weakest correlation to individual learning at .4157. A plausible reason for these results may be that knowledge sourcing was high for the

respondents because they seek experience and information related to the EHR system. But knowledge sourcing is not the first alternative to gathering information about EHR system. Physician would rather figure out the resolution on their own before seeking help. Some hospitals have neglected to do formal training of EHR system. In absence of formal training, some hospitals such as Cleveland Clinic have developed EHR tip sheets and EHR help buttons. These types of tools are great sources of information for physicians that are struggling with EHR functionality.

Nurses are the first sources that physicians utilize, if there are questions or request related to patient care. Patient safety is important to nurses. For example, physicians might seek help from nurses if they are struggling to execute a task in the EHR system. For example, physicians might seek help from nurses if they are struggling to execute a task in the EHR system. Nurses are on the front line and they must ensure patients are taken care of and comfortable with the services being provided. Physicians have been challenged with the use of EHR system and most physician are seeking knowledge about the EHR to learn from the experience of others such as nurses. Documentation is an important aspect of the patient's clinical picture and is a factor in communication among health care team members regarding patient care. Physicians might rely on nurses to document patient visits or nurses are asked to provide EHR assistance. It is not usual for some physicians to seek out experience and expertise related to the EHR system.

### **Learning Orientation**

Learning orientations specifies an individual desire to improve their competence through new skills and overcome challenges. Most physicians were forced to learn a new competence and skill to use the EHR system. While most physicians argued that learning,

the new system was a challenge. They understood that learning the new system was a necessary task in order to maintain their practice. A learning orientation is a mind-set that motivates an individual to develop his or her competence. Physicians possess the internal mindset to learn the EHR system. The biggest obstacle that hospitals face is the resistance from physicians to learn the new system because it is contradictory of the “old way of doing things” or the issue related to the disruption of patient care.

The finding suggests that learning orientation had the weakest linkage to individual learning, but it was still significant. Chapter 5 Table 4, learning orientation has a high correlation to individual learning at .4913. The results support a physician’s desire to acquire new competence as technology becomes the new norm for healthcare organizations. A plausible reason for these results may be that learning orientation plays a role in how physicians overcome challenges related to the EHR system. For example, some physicians had to overcome issues related to the lack of technical skills. Physicians have a central role in the use of the EHRs, as they are who provide much of the information that the systems handle in their automated processes. EHR systems require a fair amount of user knowledge and aptitude, which can cause hardships for physicians who weren't trained to use the technology. There is a learning curve for physicians as it relates to EHR.

### **Motivation to Learn**

Motivation to learn refers to the desire to engage in development activities, to learn new content, and to embrace the experience. Physician ability and motivation to learn the EHR system has been debated with whether it is the right thing to do for the patient. Physicians are not motivated to learn the EHR system because it interferes with their existing work routines. Motivation to learn is a key determinant of the choices individuals

make to engage in, attend to, and persist in learning activities. If a physician has high motivation, they are more likely to have a positive outcome. Some hospitals are improving motivation of health care professionals to learn and train on using EHRs by providing them with direct and indirect incentives, including overtime payments, bonuses and rewards for the hospital sections and departments successfully implementing EMRs.

The finding suggests that motivation to learn influences individual learning. Chapter 5 Table 4, motivation to learn has the second highest correlation to individual learning at .5229. The results support a physician's motivation to learn when new processes and technologies are introduced into the organization. For example, the healthcare industry is always changing with the introduction of breaking medical knowledge and technology and physicians must demonstrate a need to engage in new activities. A plausible reason for this finding is that physicians are constantly learning and must demonstrate a willing to learn in order to be successful in the profession. In the context of EHR, most physicians were introduced to the new system without formal training and learning had to become self-motivated.

### **Environmental Turbulences**

Environmental turbulence refers to change associated with product and process technologies in the industry in which a firm is entrenched. Healthcare has face immense changes since the Affordable Care Act, EHR Meaningful use and HITECH Act. Hospitals have transition their focus on whether technology will support the models of care delivery that will achieve broader policy goals: safer, more effective and more efficient care. In health-care most stakeholders have conflicting goals as it relates to technology, including quality-of-life, accessibility, trust, safety, convenience, patient-centeredness, and

communication. Hospital workflow has become radically different, and the change is due to the introduction of EHR. Physicians are faced with challenges on how they are able to adapt to change, elicit tacit knowledge, and construct histories of insights and catalog them. The legislative changes continue to impact the healthcare industry and uncertainty is a reoccurring theme in physician discussion related to technology and the future state of healthcare.

The finding suggests that environmental turbulence moderates the relationship between individual learning and routine use of EHR. As seen in Chapter 5 Table 6, environmental turbulence as a moderator has a significantly negative path coefficient. Thus, the higher environmental turbulence the less individual learning will occur and lead to less Routine use of EHR. The results support that the most healthcare organization are faced with environmental turbulence. For example, technological advances are seen as disruptions to a physician day-to-day activity. A plausible reason for this finding is that physicians feel his or her environment related to job responsibilities is constantly changing with introduction of new technology. The initiation and adoption of EHR has been particularly challenging due to the complexity of dealing with multiple stakeholders and public policy guidelines. Technology will continue to be in the forefront of healthcare and physician must continue adapt to the changes that are put in place. Hence, while healthcare is becoming increasingly complex, physicians view their work harder and more multifaceted.

### **Routine Use of the EHR**

Routine use of the EHR refers to regular and standard use of EHR systems by health care professionals, whereby the EHR system is no longer perceived as being new



or out-of-the-ordinary. For any new technological innovation such as EHR to be routinized, physicians support as well as ability and willingness to learn about the system are critical. Routines are crucial to all organizations. Hospitals have ignored the importance of establishing routines, which has led to medical mistakes, inefficiencies, and non-standardize use of the system. Hence, it is important to understand both how they can be built and how they can be changed. Routines are imperative for analyzing hospital workflows, for understanding how knowledge is retained and transferred, for the development of business strategy, and for the creation of policies to encourage more beneficial business practices.

The finding suggests that routine use of the EHR was impacted by individual learning. The results support that routine use can be created through individual learning. Routine use of EHR is key to achieving the promised benefits of EHR implementations such as increase in efficiency, improvements in the quality of care, and reduction in medical errors. A plausible reason for this finding is that physicians individual learning is the key to establishing routines. For any new technological innovation such as EHR to be routinized, physicians support and willingness to learn about the system are critical. While routines could seem repetitive in nature, research has seen the benefits to the environment overall.

### **6.3 Theoretical Implications**

Our findings indicate that individual learning have significant effect on routine use of EHR. Individual factors have been important to learning and this study showed that these individual factors are based on willingness to learn. Our findings showed that absorptive capacity had significant influence on individual learning. While learning

orientation had the weakest relationship with individual learning. There has been a gap in the learning literature in the healthcare context. This study attempts to look at how learning can lead to routines as it relates to EHR system. Past literature has typically examined social and individual factors effects separately. Social factors have been shown important in healthcare context. For example, prosharing norms are prevalent among physicians because there is a degree of consensus with regard to sharing and collaboration. Researchers have stressed the importance of considering effects of social factors in a learning context. This suggest that research should look at the interaction between individual and social factors in the formation of routines.

Second, drawing on the theoretical perspective of routines. Routines was multi-dimensional. Each dimensional was significantly influence by individual learning. Individual learning is one context that routines was studied in this research. The possibility of broadening the scope and studying at a multi-level perspective might provide more insight. This study focused on individual learning, future studies could encompass group and organization level learning. This perspective would provide insight into the overall organizational learning system.

Third, as part of empirical study, we have developed scales measuring routine use of EHR – task, work practice, and patient care- in the context of individual learning. The scale exhibited adequate reliability and validity as per the results of the pilot and full-scale studies. There and other scales adapted from prior studies may be useful for future research on routines. Prior reviews have dealt primarily with theoretical analysis as there had been little empirical research to review. Most reviews raised concerns about the lack of empirical research.

#### **6.4 Practical Implications**

This research has important implications for hospitals investing in EHR systems and wanting to take advantage of the billions of dollars in incentives the federal government has made available for hospital EHR adoption. This research aims to provide specific guidelines for healthcare organization to transition from the EHR implementation phase to the routinization phase. This research carries meaningful value in helping hospitals address the adaptation and learning that must take place in order to achieve effective routinization. The interactions between learning and routines, identified in the model, should help hospitals better manage the implementation process to achieve more desirable outcomes. This study identifies some steps that hospitals should address based on the research findings.

**The introduction of the technology system into the culture.** The way an organization introduce an innovative technology in their environment can have a favorable or unfavorable effect on the culture. For example, a local hospital introduced the EHR system through email and had expectations that the physicians, nurses, and clinicians would embrace the system and learn how to use the system. In this example, the hospitals experienced a number of issues: resistance, workarounds, and patient care inefficiencies. The hospital assumed that physicians and staff embodied the willingness to engage in individual learning. Hospitals must address the change issue in the most effective way. While, most physicians have complained about the disruption of their normal work routine when technology has been introduced. Hospitals should create a formal plan on how to introduce the system in the hospital environment and address issues upfront with top level

management support. Ultimately, hospitals should create a long-term vision on how to create routine use of the system.

**The integration of the technology system into patient care.** Routines are increasingly becoming recognized as an essential component to successful integration of EHR technology. Clinical workflow is often characterized in terms of the pattern of actions clinicians utilize to perform routine tasks and generate results. Physicians are responsible for working through the complexity of diverse tasks associated with the EHR system. Most physicians have expressed concerns over EHR implementations and the potential impact it may have on routine workflow and productivity. Hospitals must find a way to integrate EHR into the daily workflow. EHR systems will have little impact on performance, if they are not well integrated into the daily workflows of care providers.

**Identify physicians to champion building routine use.** Physicians are in the right position to be a champion and lead the organization in building routines. Physician champion has been a suggested role for healthcare technology implementations and the presence of champions is important. Physician champions refers to an individual who emerge to take creative ideas (which they may or may not have generated) and bring them to life. Physician champions can make a decisive contribution to the innovation process by actively and enthusiastically promoting the innovation, building support, overcoming resistance, and ensuring that the innovation is implemented. Physician champion can help other physicians understand the importance of routines and encourage individual learning in hospital environment.

## **CHAPTER VII**

### **LIMITATION AND FUTURE RESEARCH**

#### **7.1 Limitations**

While most hospital related studies sample sizes are low, we still must acknowledge the issues related to low sample size. The first issue is related to power. Small sample size can lead to low statistical power. Statistical power refers to the ability of a statistical test based on some sample show traits that truly exist in the population. Second, there is a probability of a Type II error occurring and it means that the test's results are not true and err on the side of being no interesting traits in the population used in the study. Lastly, an issue with significance can arise meaning if the sample size is too small, the difference cannot be detected.

We have chosen self-selection to obtain our sample. Self-selection sampling is a type of non-probability sampling technique. Non-probability sampling focuses on sampling techniques that are based on the judgment of the researcher. Therefore, self-bias will play a role in our study. Since the potential research subjects volunteered to take part in the survey. There is likely to be a degree of self-selection bias. For example, the decision

to participate in the study may reflect some inherent bias in the characteristics/traits of the participants (e.g., an administrator with a 'chip of his shoulder' wanting to give an opinion). This can either lead to the sample not being representative of the population being studied or exaggerating some particular finding from the study.

Most researchers concur that common method variance (i.e., variance that is attributable to the measurement method rather than to the constructs the measures represent) is a potential problem in behavioral research. It is also possible that common method variance had some impact in the relationships between the study variables (Lindebaum & Cartwright, 2010). However, common methods bias can be avoided by gathering data for the independent variables and dependent variables from different methods, or, if a single method is used, to test it through Harmon single factor test. In this case, no single variable represented more than 50% of the variance.

I acknowledge that a cross-sectional survey has limitations. The limitations of this study's design are such that inference about a causal pathway is theoretical if based on this data. The cross-sectional nature of the study design, causal inferences cannot be made. The cross-sectional study design does not allow any causal inferences to be made from the data, as temporality in the relationships between variables cannot be established. However, the cross-sectional study was used to look for and examine relationships between variables; to test out ideas and hypotheses; to help decide which explanation or theory best fits with the data; and to help establish causal direction but not to prove cause.

Lastly, to account for the lack of pre-validated scales for measuring routine use of EHR, I created my own measure of this construct based on physician inputs and health-care literature. As such, this construct is health-care-specific, however we generalized the

construct to apply to other IS systems. We recommend future researchers to consider refining and revalidating our measures of these constructs.

## **7.2 Future Research**

Beyond suggested research stemming from limitations of this study, there are other future issues that should be addressed. We suggest that a longitudinal study is conducted to assess routine use of EHR over a period of time. Longitudinal studies are subject to several threats to internal validity, including history (extraneous effects affecting the outcome), maturation (subjects becoming tired, gaining experience, etc.), testing (posttest responses conditioned by subject's memory of pretest responses), mortality (subjects dropping out during the course of the study), and regression effects (extreme scores during pretest regressing toward average scores during the posttest) (Huck et al. 1974). No research method is free of limitations. Through previous IT literature review (e.g., Davis et al. 1989; Venkatesh and Davis 2000), you can access the appropriate time periods to minimize history and mature effects.

Learning curves have been study in organization learning literature since the beginning of time. We can acknowledge that there are currently more empirical studies related to learning rather than studies on learning curves. Several studies have demonstrated the link between performance improvement and cumulative experience. While past studies in the hospital literature, typically examine improvements in procedures. There are two area of research that have received little attention related to learning curves: user learning linked with technologies and firm and organization level differences associated with learning curves. It is important to investigate the drivers of learning to understand the rate of an individual progress in gaining experience or new skills. Future

research can focus on organizational and managerial factors that can affect learning curves rates in an organization.

Lastly, we suggest exploring the relationship between routine and habit. Habits are commonly understood as “learned sequences of acts that become automatic responses to specific situations, which may be functional in obtaining certain goals or end states” (Verplanken et al. 1997, p. 540). Some researchers believe that routines are established by individual habits. IS habit has been defined as the extent to which individuals tend to perform behaviors with the use of IS routinely because of learning. Learning literature suggests that routines operate through the triggering of individual habits and routines are the organizational analogue of individual habit. While habit research has found little attention in the IS literature (Bergeron et al. 1995; Karahanna et al. 1999; Tyreand Orlikowski 1994), over the years it has been extensively studied in other disciplines. Future research can empirically explore the relationship between individual habits and routines in the IS context.



## **CHAPTER VII**

### **CONCLUSION**

EHRs and physician use of EHR have been touted as important ways to decrease health care costs, improve quality, and promote greater patient involvement in their health care decision making. One of the ways EHRs can perform its associated task is through formalized business processes. In hospital settings, clinical routines identify the regular pattern of activities that physicians must engage in as they administer patient care. Routines are regular, repetitive action patterns performed by multiple actors, are frequently recognized as a key organizational capability, offering competitive advantage. Routines in health care are seen as a black box because processes of care delivery are exceedingly complex and involve significant coordination, interdependence, and interactions among care providers. In health care, routines are at the core of daily operations in hospitals and play a pivotal role in determining efficiency and quality of care (Greenhalgh 2008). Formalized processes and daily workflows are interconnected in hospital environments.

Physicians are challenged to integrate routines in their daily workflow. Individual learning is crucial factor that could assist physicians in accomplishing the integration.

## APPENDICES

### Appendix A: Definitions of Organizational Learning

Author(s)	Definition
Argyris & Schön, 1978	A process of detecting and correcting errors.
Cavaleri & Fearon, 1996	The purposeful creation of shared meanings derived from the common experiences of people in organizations.
Crossan et al., 1995	A process of change in cognition and behavior...it does not necessarily follow that these changes will directly enhance performance.
Daft & Weick, 1984	1) Knowledge about the interrelationships between the organization's action and the environment.
Day, 1994	The following processes: open-minded inquiry, informed interpretations, and accessible memory.
Fiol & Lyles, 1985	The process of improving actions through better knowledge and understanding.
Garvin, 1993	A learning organization is an organization skilled in creating, acquiring, and transferring knowledge and at modifying its behavior to reflect new knowledge and insights.
Huber, 1991	An entity learns if, through its processing of information, the range of its potential behaviors is changed.
Kim, 1993	Increasing an organization's capacity to take effective action.
Lee et al., 1992	The OL process is viewed as a cyclical one in which individuals' actions lead to organizational interactions with the environment. Environmental responses are interpreted by individuals who learn by updating their beliefs about cause-effect relationships.
Levinthal & March, 1993	OL copes with the problem of balancing the competing goals of developing new knowledge and exploiting current competencies

	in the face of the dynamic tendencies to emphasize one or the other.
Levitt & March, 1988	Organizations are seen as learning by encoding inferences from history into routines that guide behavior.
Marquardt, 1996	An organization which learns powerfully and collectively and is continually transforming itself to better collect, manage, and use knowledge for success.
Meyer-Dohm, 1992	The continuous testing and transforming of experience into shared knowledge that the organization accesses and uses to achieve its core purpose.
Miller, 1996	Learning is to be distinguished from decision making. The former increases organizational knowledge, the latter need not. Learning may in fact occur long before, or long after, action is taken.
Mills & Friesen, 1992	A learning organization sustains internal innovation with the immediate goals of improving quality, enhancing customer or supplier relationships, or more effectively executing business strategy, and the ultimate objective of sustaining profitability.
Nadler et al., 1992	Learning requires an environment in which the results of experiments are sought after, examined, and disseminated throughout the organization.
Senge, 1990	Learning organizations are organizations where people continually expand their capacity to create the results they truly desire, where new and expansive patterns of thinking are nurtured, where collective aspirations are set free, and where people are continually learning how to learn together.
Slater & Narver, 1995	The development of new knowledge or insights that have the potential to influence behavior.
Scwandt & Marquardt, 2000	A complex interrelationship between people, their actions, symbols, and processes within the organization.
Stata, 1989	The principal process by which innovation occurs.... [T]he rate at which individuals and organizations learn may become the

only sustainable competitive advantage, especially in knowledge-intensive industries.

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Source: Bontis et al., 2002

## Appendix B: Organization Rountization Literature

Authors	Technology	Level	Data Source	Major Findings
Yin, 1979	Routinization of computer assisted instruction, police computer systems, mobile intensive care units, closed-circuit TV, breadth testing and fire jet-axe	Organization	19 case studies and 90 telephone interviews recording the life history of each innovation	Routinization for task-specific innovations depended upon visible benefits and wide spread user acceptance. Routinization for task diverse innovations depended upon the presence of a coordinator innovation champion and manager support.
Ritti and Silver, 1986	Institutionalization within interorganizational relations in a innovative bureau within a state regulatory commission	Organization	Documentation & observations from Bureau of Consumer Services	The development of myths to convey unquestioned belief about the origins, functions, technical efficacy, and environment needed to adopt an innovation occur early in the institutionalization process. The myth building process is ceremonial, consisting standardized procedures and behaviors that enact and perpetuate the myth.
Link and Tasse, 1988	Use of metal-cutting machine tools in US manufacturing	Organization	9 standards identified by unpublished report. Westinghouse	Findings support that standard (interface standards) do influence the diffusion and use of technology

			Corp. 1973-1984	(numerically controlled metal cutting machine tools).
Zmud and Apple, 1992	Infusion of supermarket scanning technology	Organization	Archival data and interviews from scanning coordinators at 52 chains	Infusion was positively associated with earliness of adoption, diffusion, and routinization of technology. Complete diffusion was observed in chains with high routinization and infusion.
Dean, Yoon, and Susman, 1992	Structural impacts of advanced manufacturing in metal industry	Organization	Questionnaires from executives at 185 US metal working plants	Computer usage and structural differentiation was positively related to formalization. Computer use and integrative use were positively related to decentralization. Hint that formalization provides a mean for safely decentralizing.

Adapted: Saga & Zmud, 1994

### Appendix C: IT Continuance at Individual Level Literature Review

Author (Source/ Year)	Research Problem	Theory	Independent/Dependent/ Moderator or Mediator Variables	Results
Karahanna, Straub, and Chervany (MISQ, 1999)	Understanding beliefs that influence pre-adoption versus post-adoption user intentions	Theory of reasoned action (TRA) and innovation diffusion theory (IDT)	DV: Behavioral intention about IT usage (BI) IV: (1) Perceived voluntariness of IT usage, (2) Attitude toward IT usage (with behavioral beliefs as antecedents: Perceived usefulness (PU), Image, Compatibility, Perceived ease of use (PEU), Visibility, Result Demonstrability and Trialability), (3) Subjective Norm (SN) (with normative beliefs as antecedents: Top management, Supervisor, peers, Friends, MIS Department and Local Computer Specialists)	SN dominates prediction BI to adopt IT, but attitude predominates for BI to continue using the IT. Adopter attitude influenced by trialability, PU, result demonstrability, visibility, and PEU, but post-adoption attitude is influenced by PU and Image. Significant referent groups for adopters are top management, friends, supervisors, peers, and the MIS department, while that for post-adoption users are peers, local computer specialists, top management, and supervisors.
Bhattacharjee (MISQ, 2001)	Understanding predictors of IT continuance	Expectation-confirmation theory (ECT)	DV: Continuance Intention IV: (1) Perceived usefulness (PU) (which in turn is influenced by confirmation of expectation from prior IT use),	Satisfaction is the strongest predictor of users' continuance intention, followed by PU. Satisfaction is predicted primarily



<b>Author (Source/ Year)</b>	<b>Research Problem</b>	<b>Theory</b>	<b>Independent/Dependent/ Moderator or Mediator Variables</b>	<b>Results</b>
			(2) Satisfaction (which is influenced by confirmation and PU)	by users' confirmation and secondarily by PU.
Bhattacharjee (DSS, 2001)	Predicting intention to continue using business-to-consumer e-commerce services	ECT	DV: Continuance intention IV: (1) Loyalty incentives, (2) PU (with confirmation of expectations as antecedent), (3) Satisfaction (with confirmation as antecedent)	(1) Continuance intention is determined by satisfaction, PU, and the interaction between PU and loyalty incentives. (2) Confirmation is a significant predictor of satisfaction and PU.
Bhattacharjee and Premkumar (MISQ, 2004)	Understanding changes in beliefs and attitude from pre-adoption to post-adoption IT usage.	ECT and TAM	DV: Usage intention IV: (1) PU in pre-adoption and post-adoption stages (with disconfirmation as antecedents), (2) Attitude in pre-adoption and post-adoption stages (with satisfaction and PU as antecedents)	(1) PU and attitude change between pre-adoption and post-adoption stages; this change is more prevalent during pre-adoption stage than in post-adoption stage. (2) Disconfirmation and satisfaction explain a greater proportion of the variance in later PU and Attitude than that explained by the prior states of these cognitions.

<b>Author (Source/ Year)</b>	<b>Research Problem</b>	<b>Theory</b>	<b>Independent/Dependent/ Moderator or Mediator Variables</b>	<b>Results</b>
Ahuja and Thatcher (MISQ, 2005)	Understanding effects of work environment perceptions and gender on (post-adoptive) IT innovation	Theory of Trying	DV: Trying to innovate with IT IV: Work Environment Perceptions: (1) Autonomy, (2) Overload (and also their interaction) MV: Gender	Work environment perceptions influence trying to innovate with IT. (2) Gender moderates the relationships between work environment perceptions and trying to innovate
Hong, Thong and Tam (DSS, 2006)	Comparing the efficacy of different models in predicting users' continued IT usage behavior	ECT, TAM and extended ECT (by combining ECT and TAM constructs)	DV: IT continuance intention IV: (1) Satisfaction (with PU and Confirmation as antecedents), (2) PU (with Confirmation as antecedent), (3) Perceived ease of use (PEU)	1) Extended ECT (ECT+TAM) explained most of the variance in continuance intention, followed by TAM, and then ECT. (2) TAM fit the data best, followed by ECT, and extended ECT. (3) PU has a significant impact on continuance intention in all models. (4) Impact of PEU on continuance intention is stronger than that of PU in TAM and Extended ECT.
Wu, Gerlach, and Young	Understanding motivation	Expectancy-Value	DV: Continuance intention	(1) Continuance intention is predicted by

Author (Source/ Year)	Research Problem	Theory	Independent/Dependent/ Moderator or Mediator Variables	Results
(I&M, 2007)	factors that influence open source software developers' continuance intention	Theory (EVT)	IV: (1) Motivation for helping, enhancing human capital, career advancement, and personal satisfaction (2) Satisfaction (with Motivators as antecedents)	satisfaction and motivation on enhancing human capital and satisfying personal needs. (2) Motivation on helping and career advancement have positive effects on satisfaction and indirect (but not direct) positive effects on continuance intention.
Chiu, Chiu and Chang (ISJ, 2007)	Investigating motivations behind learners' intentions to continue using web-based learning	Delone and Mclean's IS success Model and Fairness Theory	DV: Continuance intention IV: (1) Interactional fairness, (2) Procedural fairness, (3) Distributive fairness, (4) Satisfaction (with Information quality, System quality, Service quality, System use, Distributive fairness, Procedural fairness and Interactional fairness as antecedents)	(1) Continuance intention is primarily explained by satisfaction. (2) Procedural fairness has a significant effect on continuance intention. (3) Information quality, System quality, System use, Distributive fairness and Interactional fairness have positive effects on satisfaction.

## Appendix D: Construct Definitions

<b>Construct</b>	<b>Definition</b>	<b>Citation</b>
<b>Routine Use of EHR</b>	refers to regular and standard use of EHR systems by healthcare professionals, whereby the EHR system is no longer perceived as being new or out-of-the-ordinary.	Saga and Zmud, 1992
<b>Individual learning</b>	refers to knowledge acquisition, which can occur only when individuals have both the ability (“can do”) and the desire (“will do”) to acquire new knowledge.	Noe, 1986; Wexley and Latham, 1991
<b>Absorptive Capacity</b>	reflects a learner’s mental representation and indicates the ability to acquire new knowledge by relating it to existing knowledge	Kankanhalli et al., 2012
<b>Knowledge Sourcing Initiative</b>	refers to individuals’ intentional efforts to locate and access others’ expertise, experience, and viewpoints.	Kankanhalli et al., 2012
<b>Learning Orientation</b>	indicates the individual’s desire to improve competence by acquiring new skills and overcoming challenges.	Kankanhalli et al., 2012
<b>Motivation to Learn</b>	Motivation to learn encompasses the desire to engage in development activities, to learn new content, and to embrace the experience.	Noe, 1986
<b>Environmental Turbulence</b>	defined as the degree of change associated with product and process technologies in the industry in which a firm is embedded.	Hanvanich et al., 2013

## Appendix E: Cover Letter

### Informed Consent

Dear Participant,

My name is Michele Heath. I am a faculty member in the Management department at Cleveland State University. I am requesting your participation in my research study. The study aims to investigate routinization of electronic health records (EHR). In this research, EHR routinization is defined as a stage where the EHR system is no longer perceived as being new or out-of-the-ordinary and has become institutionalized. You will be asked to participate in a web survey. The total time involved is about ten minutes. To participate, you must be at least 18 years of age. You must have experience with utilizing EHRs. No personal identifiers will be included in such data. There are no direct benefits available to you as a participant in this research. Your responses are completely anonymous. Risks associated with participation are considered to be minimal. Such risks are largely limited to compromised confidentiality. To minimize such risks, the personal data page for the pre-test will be separated from your response sheet. Furthermore, a link list will be used to assign a confidential code to each completed survey. The link list is used to match your pre-test with your post-test. It will be kept separate from the survey. All research documents will be secured in a locked file cabinet in my CSU campus office. All link lists will be destroyed by shredding once the match has been made. You are free to skip any items you choose not to respond to. You may withdraw from this study at any time without any consequence whatsoever. Only summary results may be published, presented or used for instruction. No personal identifiers will be included in such data. There are no direct benefits available to you as a participant in this research. You can reach the principal investigator, Ms. Michele Heath, at m.heath@csuohio.edu, or the co-principal investigator, Dr. Raymond Henry, at r.henry22@csuohio.edu, if you have any questions. Please feel free to print a copy of this screen for your records. Please read the following: ***“I understand that if I have any questions about my rights as a research subject, I can contact the Cleveland State University Institutional Review Board at (216) 687-3630.”***

Please check the following box, if you are 18 years or older:

- I am 18 years or older (1)

## Appendix F: Survey Instrument

### Screener question:

### Survey starts:

To what extent do you agree or disagree to the following statements:

SC 1	How often do you use the EHR system? Everyday 2-3 times a week Once a week Never
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End the survey if the physicians have never used the electronic health records.

### Survey starts:

To what extent do you agree or disagree to the following statements:

View on HER	
V1	EHR is a necessity for managing patient visits.
V2	EHR creates a disruption in my work environment.
V3	EHR creates efficiencies in managing patient visits.
V4	EHR use should not be mandatory for patient visits.
Routine use of EHR- Tasks	
RT1	The EHR tasks I complete are the same from day-to-day.
RT2	Tasks in the EHR system work the same way for all of my patient.
RT3	The use of the EHR system is integrated in my daily routine.
RT4	The tasks associated with the EHR system are repetitious.
RT5	The EHR system works the same way most of the time.
RT6	The use of the EHR system to accomplish my task doesn't require much thought.
RT7	The EHR system is routine.
Routine use of EHR- Work Practices	
RW1	There is a clearly known way to use the EHR system.
RW2	There is a clearly defined body of EHR knowledge which can guide me in using the EHR system.
RW3	There is an understandable sequence of steps that can be followed when using the EHR system.
RW4	There are actually established procedures and practices to use the EHR system.
RW5	There is a logical sequence of steps in the EHR system that can be followed when carrying out my work.

Routine use of EHR – EHR Patient Care	
RP1	The EHR system is not useful for completing my patient visits.
RP2	The EHR system supports procedure for patient care.
RP3	My patient visits cannot be conducted without the EHR system.
RP4	The EHR system plays an important role in patient visits.
RP5	The EHR system is a tool to use during patient visits.
Individual Learning	
IL1	I have the ability to obtain EHR system training tools while I am using the EHR system.
IL2	I have the ability to recognize and acquire information on how to use the EHR system to positively affect my job-related tasks.
IL3	I am willing to learn more about the EHR system to enhance my effectiveness in my current position.
IL4	I am willing to assess my current EHR knowledge to identify my knowledge gaps or learning needs.
IL5	I have the ability to acquire EHR job-related competency quickly.
Absorptive Capacity	
AB1	I use prior knowledge of technology to facilitate my use of the EHR system.
AB2	I try to interrelate new EHR learning with prior and related knowledge.
AB3	I find it easy to create associations and linkages between my prior knowledge of technology and the use of EHR system.
AB4	My previous background can assist me with the use of the EHR system.
Knowledge Sourcing	
KS1	I make use of EHR tip sheets, EHR help buttons, and documents on the internet to search for information related to the EHR system.
KS2	I approach my staff to search for information related to the EHR system.
KS3	I approach clinical colleagues to search for knowledge related to the EHR system.
KS4	I use targeted one-on-one conversations with other physicians to obtain EHR related information.
Learning Orientation	
LO1	I take up challenging EHR tasks that can enhance my EHR skills and learning.
LO2	I put in extra effort so that I can enhance my EHR skills and learning.
LO3	I take up challenging tasks where I can learn new EHR skills.
LO4	I look for opportunities to enhance my EHR knowledge and learning.
Motivation to Learn	
ML1	I will discuss with my department chair ways to develop my EHR skills.
ML2	I will discuss with my colleagues ways to develop my EHR skills.
ML3	I will practice using my EHR skills that I have learned.
ML4	I will set specific goals for maintaining my EHR skills that I have learned.
ML5	I will seek expert help/advice in order to maintain my EHR skills.
ML6	I will examine my work environment for potential barriers to using my EHR skills.
ML7	I will monitor my success at using my EHR skills that I have learned.
Environmental Turbulence	

ET1	In my organization, my patients' involvement in their own healthcare has changed quite a bit over time.
ET2	In my organization, attracting and retaining patients is a lot more competitive.
ET3	In my organization, EHR technology is changing rapidly.
ET4	In my organization, EHR technological advances provide better access to patient information for better healthcare.
ET5	In my organization, it is difficult to forecast where the EHR technology will be in the next 2–3 years.
ET6	In my organization, EHR technological developments have created a disruption to day-to-day activities.

Demographics	
DG1	Gender
DG2	Age
DG3	How long have you used EHR system?
DG4	Please indicate your tenure as a physician.
DG5	Please select your specialty area (revise) <u>Specialty area list</u> Internal Medicine OBGYN Pediatrics Family Medicine Other Medical Sub-specialty Surgery Surgical Sub-specialty Emergency Geriatrics
DG6	How would you characterize your practice? Private practice/academic medicine/community physician government/ employee of the system
DG7	Do you currently manage the care of patients while they are inpatients in a US hospital?
DG8	Are you currently employed by the hospital? (for example: if you are community physician, please answer no) Yes (i.e. full time employee) No (i.e. community physician)
DG9	How often do you use the EHR system? Everyday 2-3 times a week Once a week Never
DG10	What type of hospital do you work for? Public Hospitals Federal Hospitals

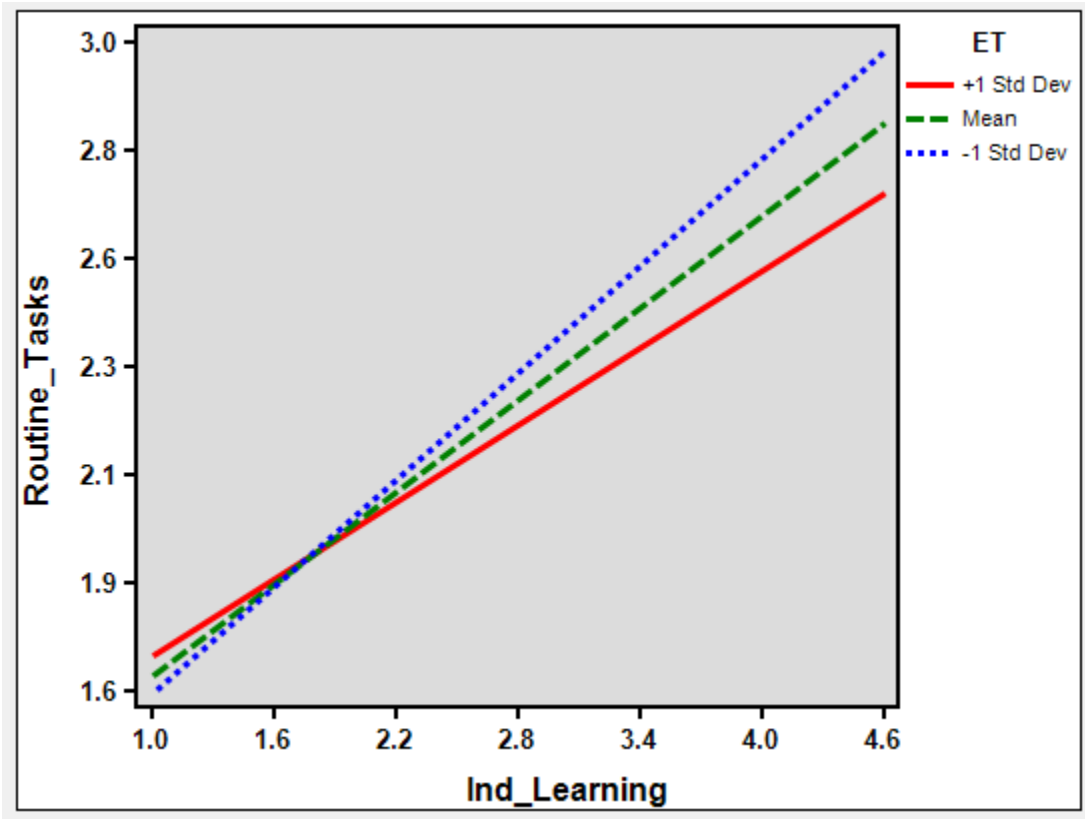


	Voluntary Hospitals Proprietary Hospitals System Teaching Hospitals Academic Hospitals Church-related Hospitals
DG11	Are there supplemental EHR training materials available in your organization?
DG12	Was training available when the new EHR system was introduced to the hospital staff?
DG13	What EHR system are you currently working using?

Thank you for your participation.

**Appendix G: Interaction Analyses**

**Moderation Analysis -Routine Use of EHR- Tasks**



##### BEGIN INTERACTION ANALYSIS #####

Tuesday, January 30, 2018 2:03:08 PM

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\*\*\*\*\* MODEL SUMMARY \*\*\*\*\*

R: 0.390693382  
R Square: 0.152641318  
R Square Adjusted: 0.135465129  
Standard Error of the Estimate: 0.522009258  
R Square Contribution of the Interaction Term(s): 0.003870474

RESEARCH MODEL: Y = B1X1  
+ B2X2  
+ B3X1X2

+ B0

WHERE: Y = Routine\_Tasks

X1 = Ind\_Learning

X2 = ET

B0 = Regression constant

\*\*\*\*\* END MODEL SUMMARY \*\*\*\*\*

\*\*\*\*\* MODEL ANALYSIS OF VARIANCE \*\*\*\*\*

	Sum of Squares	Degrees of Freedom	Mean Square	F	Significance
Regression:	7.264788139	3	2.421596046	8.886797563	0.000018764
Residual:	40.32906255	148	0.272493665		
Total:	47.59385069	151			

\*\*\*\*\* END ANOVA \*\*\*\*\*

\*\*\*\*\* MODEL POWER ANALYSIS \*\*\*\*\*

Effect Size (f Square): 0.180137788  
 Noncentrality Parameter (Lambda): 27.38094384  
 Critical F: 8.886797563  
 Noncentral F: 0.264992334  
 Beta (Type II Error Rate): 0.395507739  
 Observed Power: 0.604492260

\*\*\*\*\* END POWER ANALYSIS \*\*\*\*\*

\*\*\*\*\* MODEL COEFFICIENTS \*\*\*\*\*

	B	Std Error	t	Significance
(Regression constant):	0.973954553	0.555294998	1.753940799	0.081482982
Ind_Learning:	0.540890957	0.265685222	2.035833801	0.043526933
ET:	0.156890296	0.234142995	0.670061882	0.503848581
Interaction term:	-0.08961431	0.108992857	-0.82220350	0.412266131

95% CONFIDENCE INTERVALS

Lower Bound Upper Bound

(Regression constant):	-0.12325579	2.071164901
Ind_Learning:	0.015922109	1.065859805
ET:	-0.30575409	0.619534689
Interaction term:	-0.30497387	0.125745258

\*\*\*\*\* END MODEL COEFFICIENTS \*\*\*\*\*

\*\*\*\*\* INTERACTION LINE 1 \*\*\*\*\*

Moderator: ET  
Level of the Moderator: +1 Std Dev  
Simple Slope: 0.273281469  
Intercept: 1.442466020  
Standard Error of Simple Slope: 0.094087341  
Degrees of Freedom: 148  
t: 2.904550882  
Significance of Simple Slope (two-tailed): 0.004242050  
Significance of Simple Slope (one-tailed): 0.002121025

Lower Bound Upper Bound  
-----  
95% CI around the Simple Slope: 0.087353358 0.459209580

\*\*\*\*\* END LINE 1 \*\*\*\*\*

\*\*\*\*\* INTERACTION LINE 2 \*\*\*\*\*

Moderator: ET  
Level of the Moderator: Mean  
Simple Slope: 0.326681312  
Intercept: 1.348977410  
Standard Error of Simple Slope: 0.065197648  
Degrees of Freedom: 148  
t: 5.010630271  
Significance of Simple Slope (two-tailed): 0.000001527  
Significance of Simple Slope (one-tailed): 0.000000763

Lower Bound Upper Bound  
-----  
95% CI around the Simple Slope: 0.197842772 0.455519852

\*\*\*\*\* END LINE 2 \*\*\*\*\*

\*\*\*\*\* INTERACTION LINE 3 \*\*\*\*\*

Moderator: ET  
Level of the Moderator: -1 Std Dev  
Simple Slope: 0.380081155  
Intercept: 1.255488801  
Standard Error of Simple Slope: 0.089918437  
Degrees of Freedom: 148  
t: 4.226954645  
Significance of Simple Slope (two-tailed): 0.000041273  
Significance of Simple Slope (one-tailed): 0.000020636

Lower Bound Upper Bound

-----  
95% CI around the Simple Slope: 0.202391309 0.557771002

\*\*\*\*\* END LINE 3 \*\*\*\*\*

\*\*\*\*\* DESCRIPTIVE STATISTICS \*\*\*\*\*

	Mean	Std Dev	N	Minimum	Maximum
Routine_Tasks:	2.0197368	0.5614187	152.00000	1.0000000	3.5714285
Ind_Learning:	2.0750000	0.6658411	152.00000	1.0000000	4.6000000
ET:	2.3903508	0.5958852	152.00000	1.0000000	4.0000000
Interaction term:	5.0392543	2.2087294	152.00000	1.0000000	12.266666

\*\*\*\*\* END DESCRIPTIVE STATISTICS \*\*\*\*\*

\*\*\*\*\* CORRELATIONS \*\*\*\*\*

Routine\_Tasks  
-----  
Routine\_Tasks: 1.000000000  
Ind\_Learning: 0.384753409  
ET: 0.050816712  
Interaction term: 0.291122792

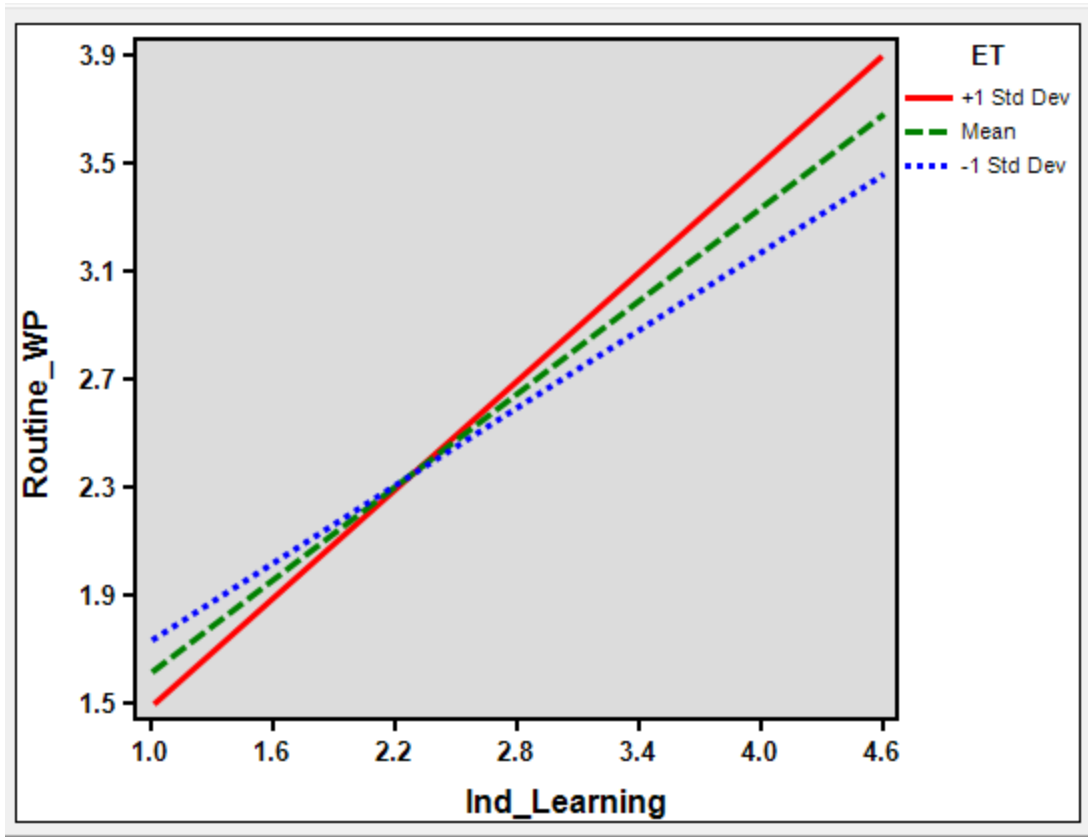
Ind\_Learning  
-----  
Routine\_Tasks: 0.384753409  
Ind\_Learning: 1.000000000  
ET: 0.201130014  
Interaction term: 0.823219831

ET  
-----  
Routine\_Tasks: 0.050816712  
Ind\_Learning: 0.201130014  
ET: 1.000000000  
Interaction term: 0.694149430

Interaction term  
-----  
Routine\_Tasks: 0.291122792  
Ind\_Learning: 0.823219831  
ET: 0.694149430  
Interaction term: 1.000000000

\*\*\*\*\* END CORRELATIONS \*\*\*\*\*

**Appendix H: Moderation Analysis -Routine use of EHR- Work Practices**



##### BEGIN INTERACTION ANALYSIS #####

Tuesday, January 30, 2018 2:09:25 PM

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\*\*\*\*\* MODEL SUMMARY \*\*\*\*\*

R: 0.468425171  
 R Square: 0.219422140  
 R Square Adjusted: 0.203599616  
 Standard Error of the Estimate: 0.724764932  
 R Square Contribution of the Interaction Term(s): 0.005757633

RESEARCH MODEL: Y = B1X1  
 + B2X2  
 + B3X1X2  
 + B0

WHERE: Y = Routine\_WP

X1 = Ind\_Learning  
 X2 = ET  
 B0 = Regression constant

\*\*\*\*\* END MODEL SUMMARY \*\*\*\*\*

\*\*\*\*\* MODEL ANALYSIS OF VARIANCE \*\*\*\*\*

	Sum of Squares	Degrees of Freedom	Mean Square	F	Significance
Regression:	21.85346360	3	7.284487868	13.86770773	0.000000051
Residual:	77.74206271	148	0.525284207		
Total:	99.59552631	151			

\*\*\*\*\* END ANOVA \*\*\*\*\*

\*\*\*\*\* MODEL POWER ANALYSIS \*\*\*\*\*

Effect Size (f Square): 0.281102183  
 Noncentrality Parameter (Lambda): 42.72753194  
 Critical F: 13.86770772  
 Noncentral F: 0.238644836  
 Beta (Type II Error Rate): 0.405690542  
 Observed Power: 0.594309457

\*\*\*\*\* END POWER ANALYSIS \*\*\*\*\*

\*\*\*\*\* MODEL COEFFICIENTS \*\*\*\*\*

	B	Std Error	t	Significance
(Regression constant):	1.927876379	0.770979318	2.500555247	0.013475050
Ind_Learning:	0.196102955	0.368881067	0.531615668	0.595778621
ET:	-0.36163967	0.325087399	-1.11243829	0.267729418
Interaction term:	0.158110882	0.151327203	1.044827886	0.297783371

95% CONFIDENCE INTERVALS  
 Lower Bound Upper Bound

(Regression constant):	0.404494234	3.451258523
Ind_Learning:	-0.53277111	0.924977023
ET:	-1.00398159	0.280702254
Interaction term:	-0.14089734	0.457119110

\*\*\*\*\* END MODEL COEFFICIENTS \*\*\*\*\*

\*\*\*\*\* INTERACTION LINE 1 \*\*\*\*\*

Moderator: ET  
Level of the Moderator: +1 Std Dev  
Simple Slope: 0.668259380  
Intercept: 0.847934936  
Standard Error of Simple Slope: 0.130632176  
Degrees of Freedom: 148  
t: 5.115580252  
Significance of Simple Slope (two-tailed): 0.000000955  
Significance of Simple Slope (one-tailed): 0.000000477

Lower Bound Upper Bound  
-----  
95% CI around the Simple Slope: 0.410114198 0.926404561

\*\*\*\*\* END LINE 1 \*\*\*\*\*

\*\*\*\*\* INTERACTION LINE 2 \*\*\*\*\*

Moderator: ET  
Level of the Moderator: Mean  
Simple Slope: 0.574043441  
Intercept: 1.063430672  
Standard Error of Simple Slope: 0.090521324  
Degrees of Freedom: 148  
t: 6.341527199  
Significance of Simple Slope (two-tailed): 0.000000002  
Significance of Simple Slope (one-tailed): 0.000000001

Lower Bound Upper Bound  
-----  
95% CI around the Simple Slope: 0.395162216 0.752924667

\*\*\*\*\* END LINE 2 \*\*\*\*\*

\*\*\*\*\* INTERACTION LINE 3 \*\*\*\*\*

Moderator: ET  
Level of the Moderator: -1 Std Dev  
Simple Slope: 0.479827503  
Intercept: 1.278926409  
Standard Error of Simple Slope: 0.124844011  
Degrees of Freedom: 148  
t: 3.843416247  
Significance of Simple Slope (two-tailed): 0.000179611  
Significance of Simple Slope (one-tailed): 0.000089805

Lower Bound Upper Bound  
-----  
95% CI around the Simple Slope: 0.233120443 0.726534563



\*\*\*\*\* END LINE 3 \*\*\*\*\*

\*\*\*\*\* DESCRIPTIVE STATISTICS \*\*\*\*\*

	Mean	Std Dev	N	Minimum	Maximum
Routine_WP:	2.2671052	0.8121410	152.00000	1.0000000	4.6000000
Ind_Learning:	2.0750000	0.6658411	152.00000	1.0000000	4.6000000
ET:	2.3903508	0.5958852	152.00000	1.0000000	4.0000000
Interaction term:	5.0392543	2.2087294	152.00000	1.0000000	12.266666

\*\*\*\*\* END DESCRIPTIVE STATISTICS \*\*\*\*\*

\*\*\*\*\* CORRELATIONS \*\*\*\*\*

Routine\_WP  
-----  
Routine\_WP: 1.000000000  
Ind\_Learning: 0.461396475  
ET: 0.065481542  
Interaction term: 0.378171438

Ind\_Learning  
-----  
Routine\_WP: 0.461396475  
Ind\_Learning: 1.000000000  
ET: 0.201130014  
Interaction term: 0.823219831

ET  
-----  
Routine\_WP: 0.065481542  
Ind\_Learning: 0.201130014  
ET: 1.000000000  
Interaction term: 0.694149430

Interaction term  
-----  
Routine\_WP: 0.378171438  
Ind\_Learning: 0.823219831  
ET: 0.694149430  
Interaction term: 1.000000000

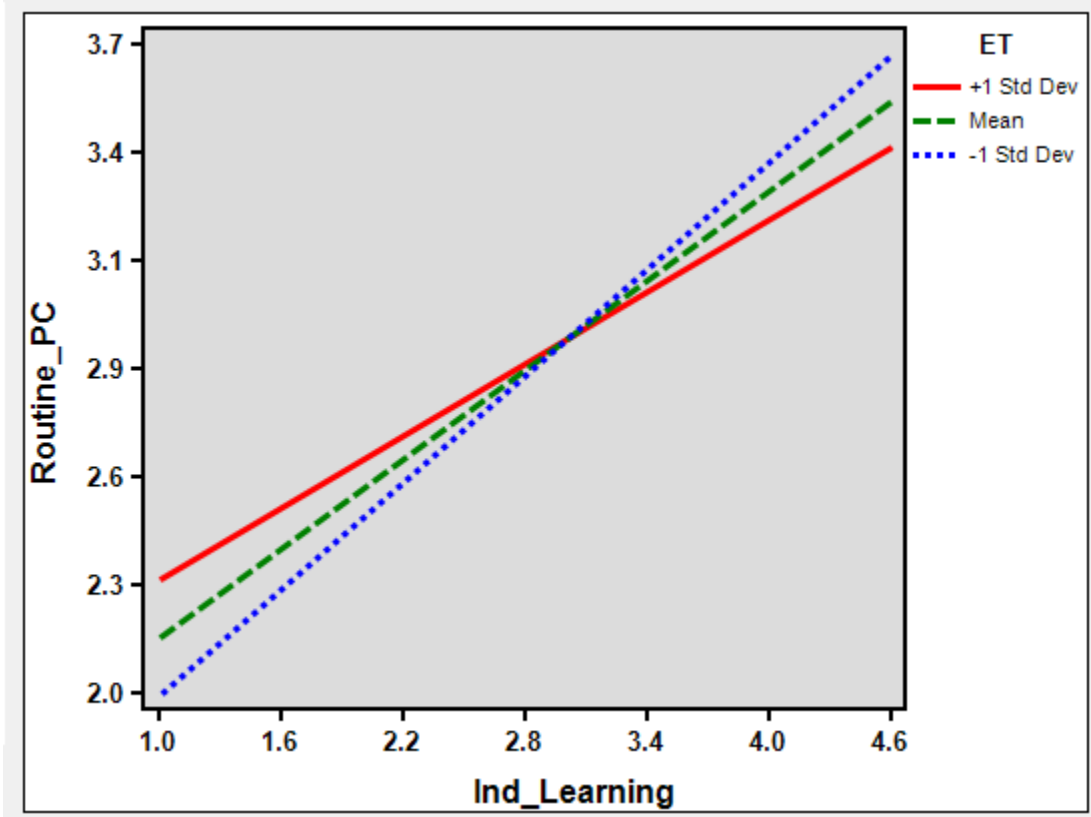
\*\*\*\*\* END CORRELATIONS \*\*\*\*\*

Total execution time: 0.0060 seconds.

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##### END INTERACTION ANALYSIS #####

**Appendix I: Moderation Analysis -Routine Use of EHR- Patient Care**



##### BEGIN INTERACTION ANALYSIS #####

Tuesday, January 30, 2018 2:18:41 PM

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\*\*\*\*\* MODEL SUMMARY \*\*\*\*\*

R: 0.435549850  
 R Square: 0.189703671  
 R Square Adjusted: 0.173278746  
 Standard Error of the Estimate: 0.598469442  
 R Square Contribution of the Interaction Term(s): 0.005493402

RESEARCH MODEL: Y = B1X1  
 + B2X2  
 + B3X1X2  
 + B0

WHERE: Y = Routine\_PC  
 X1 = Ind\_Learning

X2 = ET  
B0 = Regression constant

\*\*\*\*\* END MODEL SUMMARY \*\*\*\*\*

\*\*\*\*\* MODEL ANALYSIS OF VARIANCE \*\*\*\*\*

	Sum of Squares	Degrees of Freedom	Mean Square	F	Significance
Regression:	12.41016460	3	4.136721534	11.54974316	0.000000758
Residual:	53.00851960	148	0.358165673		
Total:	65.41868421	151			

\*\*\*\*\* END ANOVA \*\*\*\*\*

\*\*\*\*\* MODEL POWER ANALYSIS \*\*\*\*\*

Effect Size (f Square): 0.234116415  
Noncentrality Parameter (Lambda): 35.58569516  
Critical F: 11.54974316  
Noncentral F: 0.247967852  
Beta (Type II Error Rate): 0.402079689  
Observed Power: 0.597920310

\*\*\*\*\* END POWER ANALYSIS \*\*\*\*\*

\*\*\*\*\* MODEL COEFFICIENTS \*\*\*\*\*

	B	Std Error	t	Significance
(Regression constant):	0.872861985	0.636630639	1.371064997	0.172402514
Ind_Learning:	0.685197392	0.304600894	2.249492384	0.025936905
ET:	0.375654565	0.268438587	1.399405985	0.163755858
Interaction term:	-0.12516746	0.124957352	-1.00168146	0.318110611

95% CONFIDENCE INTERVALS

Lower Bound Upper Bound

(Regression constant):	-0.38505988	2.130783859
Ind_Learning:	0.083334861	1.287059923
ET:	-0.15475466	0.906063801
Interaction term:	-0.37207136	0.121736435

\*\*\*\*\* END MODEL COEFFICIENTS \*\*\*\*\*

\*\*\*\*\* INTERACTION LINE 1 \*\*\*\*\*

Moderator: ET  
Level of the Moderator: +1 Std Dev  
Simple Slope: 0.311417793  
Intercept: 1.994655210  
Standard Error of Simple Slope: 0.107868581  
Degrees of Freedom: 148  
t: 2.887011103  
Significance of Simple Slope (two-tailed): 0.004472257  
Significance of Simple Slope (one-tailed): 0.002236128

Lower Bound Upper Bound  
-----

95% CI around the Simple Slope: 0.098256262 0.524579324

\*\*\*\*\* END LINE 1 \*\*\*\*\*

\*\*\*\*\* INTERACTION LINE 2 \*\*\*\*\*

Moderator: ET  
Level of the Moderator: Mean  
Simple Slope: 0.386003235  
Intercept: 1.770808206  
Standard Error of Simple Slope: 0.074747334  
Degrees of Freedom: 148  
t: 5.164107056  
Significance of Simple Slope (two-tailed): 0.000000767  
Significance of Simple Slope (one-tailed): 0.000000383

Lower Bound Upper Bound  
-----

95% CI around the Simple Slope: 0.238293347 0.533713124

\*\*\*\*\* END LINE 2 \*\*\*\*\*

\*\*\*\*\* INTERACTION LINE 3 \*\*\*\*\*

Moderator: ET  
Level of the Moderator: -1 Std Dev  
Simple Slope: 0.460588677  
Intercept: 1.546961201  
Standard Error of Simple Slope: 0.103089046  
Degrees of Freedom: 148  
t: 4.467872114  
Significance of Simple Slope (two-tailed): 0.000015596  
Significance of Simple Slope (one-tailed): 0.000007798

Lower Bound Upper Bound  
-----

95% CI around the Simple Slope: 0.256872093 0.664305262

\*\*\*\*\* END LINE 3 \*\*\*\*\*

\*\*\*\*\* DESCRIPTIVE STATISTICS \*\*\*\*\*

	Mean	Std Dev	N	Minimum	Maximum
Routine_PC:	2.5618421	0.6582068	152.00000	1.0000000	5.0000000
Ind_Learning:	2.0750000	0.6658411	152.00000	1.0000000	4.6000000
ET:	2.3903508	0.5958852	152.00000	1.0000000	4.0000000
Interaction term:	5.0392543	2.2087294	152.00000	1.0000000	12.266666

\*\*\*\*\* END DESCRIPTIVE STATISTICS \*\*\*\*\*

\*\*\*\*\* CORRELATIONS \*\*\*\*\*

Routine\_PC  
-----  
Routine\_PC: 1.000000000  
Ind\_Learning: 0.415776119  
ET: 0.187940576  
Interaction term: 0.386659459

Ind\_Learning  
-----  
Routine\_PC: 0.415776119  
Ind\_Learning: 1.000000000  
ET: 0.201130014  
Interaction term: 0.823219831

ET  
-----  
Routine\_PC: 0.187940576  
Ind\_Learning: 0.201130014  
ET: 1.000000000  
Interaction term: 0.694149430

Interaction term  
-----  
Routine\_PC: 0.386659459  
Ind\_Learning: 0.823219831  
ET: 0.694149430  
Interaction term: 1.000000000

\*\*\*\*\* END CORRELATIONS \*\*\*\*\*

Total execution time: 0.0650 seconds.

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##### END INTERACTION ANALYSIS #####



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