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CAPITALIZING ON HEALTH INFORMATION TECHNOLOGY TO ENABLE DIGITAL ADVANTAGE IN U.S. HOSPITALS[1]

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This research examines hospital digital advantage, defined as a hospital's technological edge relative to its competitors across a composite of technologies supporting the hospital's various functions and processes. Drawing on Bourdieu's forms of capital and the logic of digital options, we develop an integrative conceptual framework to identify and organize antecedents of digital advantage, which can translate to hospital performance through the creation of digital options. Focusing on the antecedents of digital advantage for our research model and hypotheses, we suggest that digital advantage is influenced by (1) economic capital, (2) institutional-arrangement-based social capital that results in knowledge sharing through information exchange networks and parent organization membership, (3) geographic-proximity-based social capital due to locational externalities that facilitate knowledge spillover, and (4) cultural capital that reflects the hospital's health information technology (HIT) knowledge stock. Our findings, based on the aggregate adoption of 90 HITs by 953 hospitals, support main effects; complementary effects of the two forms of social capital; and substitutive effects between (1) economic capital and other forms of capital such that cultural capital and both types of social capital mitigate the effects of inadequate economic capital, and between (2) institutional-arrangement-based social capital and cultural capital such that knowledge shared through institutional arrangements mitigates the effects of having inadequate in-house HIT expertise. We also provide preliminary evidence to show that hospital digital advantage is positively associated with hospital performance.

Keywords: Healthcare information technology, adoption, diffusion, knowledge spillover, cultural capital, social capital, economic capital, institutional-arrangement-based social capital, geographic-proximity-based social capital, Saidin index, digital advantage

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Introduction

Despite the United States' spending more on healthcare per capita than other developed countries, it still demonstrates worse health outcomes (e.g., higher prevalence of chronic diseases) than its industrialized counterparts (Squires and Anderson 2015). Numerous studies have shown that health information technology (HIT)[2] can improve quality of care (e.g., lower mortality rates, reduce medical errors, improve patient safety, and increase patient satisfaction), hospital efficiency, and financial performance (e.g., lower costs, increase revenue, and increase productivity) (for a review, see Agarwal et al. 2010). More recent research shows that HIT can help hospitals survive and thrive (Sheikh et al. 2015) and remain competitive (Bakshi 2012).

Given the importance of HIT to healthcare in general, and to hospitals in particular, our study leverages insights from Bourdieu's (1986) forms of capital and the logic of digital options to examine the factors that enable hospitals to become digitally advantaged through the adoption of a portfolio of HITs. *Digital advantage* is defined as a hospital's technological edge *relative* to its competitors across a *composite* of technologies supporting the hospital's various functions and processes. Our conceptualization of digital advantage focuses on a hospital's stock of technologies relative to its competitors and captures both the number of HITs adopted and how rare these are in terms of their diffusion among hospitals. Rare technologies, "because they are expensive, new, or difficult to implement—are considered 'high tech'" (Spetz and Baker 1999, p. 20) and receive more weight in our measure of digital advantage since their rarity can be a source of differentiation. We argue that a composite of technologies supporting various functions and processes gives a hospital an edge because these technologies are a generator of digital options[3] (e.g., enable the design of IT-enabled procedures, routines, and services) (Sambamurthy et al. 2003) that enable the hospital to take better competitive actions to enhance hospital performance.

Focusing on delineating the antecedents of digital advantage, we theorize that hospital digital advantage is influenced, individually and jointly, through substitutive and complementary effects, by economic capital that reflects the hospital's financial resources, cultural capital that reflects the hospital's IT knowledge stock, and two forms of social capital: *institutional-arrangement-based social capital* that results in knowledge sharing through information exchange networks and multihospital system membership and *geographic-proximity-based social capital* due to locational externalities that facilitate knowledge spillover.

Our research contributes to the literature in three ways. First, we introduce digital advantage as a concept that captures the stock of an organization's technologies weighted by their rareness. The focus on a composite of technologies spanning various hospital functions and processes is important because it is an organization's digital advantage reflected in its stock of technologies—rather than a single technology—that is likely to generate digital options. Our measure is also relative to an organization's competitors since it weighs the rareness of the technologies *vis-à-vis* one's competitors. This technological edge is important to generating high value digital options to enable competitive performance. Second and relatedly, with few exceptions, most IT adoption studies have focused on adoption of a *single* IT (see Appendix A). There has been little attention to what leads to an organization's technology advantage. Factors leading to adoption of a single technology may be idiosyncratic to the specific technology and may not generalize to explaining digital advantage in general. Third, although our hypotheses focus on the antecedents of digital advantage, we propose an *integrative* conceptual model for digital advantage that provides an overarching framework to both identify and coherently organize antecedents of digital advantage and to explicate how digital advantage can translate to hospital performance through the creation of digital options. From a practice perspective, our study provides a recipe for hospitals to choose, based on their available forms of capital, alternative strategies to achieve digital advantage and enhance hospital performance.

The paper is organized as follows. First, we conceptualize digital advantage and present our conceptual framework. We then review literature related to Bourdieu's forms of capital to identify and coherently organize factors, derived from organizational and hospital adoption of IT, that influence an organization's accumulation of technology stock. After developing our hypotheses, we describe our research methodology, data analysis, and results. We conclude with a discussion of the contributions of our study and suggestions for future research.

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[2]HIT refers to a conglomeration of technologies and tools that are used for the storage, retrieval, analysis, sharing, and application of healthcare information, data, and knowledge for the purposes of communication and decision-making (Health and Human Services 2013).

[3]Digital options are "a set of IT-enabled capabilities in the form of digitized enterprise work processes and knowledge systems" (Sambamurthy et al. 2003, p. 247).

Theoretical Background

Conceptualizing Digital Advantage

The market of U.S. hospitals is regarded as a differentiated oligopoly where a few firms sell products or services that are differentiated on a few dimensions (Gaynor et al. 2013). Because prices are administratively regulated, vigorous competition on quality and other non-price dimensions is an important characteristic of such a market (Rivers and Glover 2008). HIT is a promising solution to help hospitals gain a competitive advantage. Research shows that hospitals are increasingly relying on HITs to help them survive and remain competitive (Bakshi 2012). For instance, hospitals that adopt less diffused technologies, such as telehealth, can leverage these technologies to provide unique services to patients and gain a competitive advantage in their market (Adler-Milstein, Kvedar and Bates 2014). Further, hospitals often leverage cutting-edge technology to attract medical expertise (primarily physicians) and patients. HITs have also been shown to reduce medical errors (e.g., Truitt et al. 2016), improve patient outcomes (e.g., Devaraj and Kohli 2003; McCullough et al. 2016), enhance patient care (e.g., King et al. 2014), improve physician productivity (e.g., Bhargava and Mishra 2014), increase hospitals' market value (Kohli et al. 2012), and positively impact hospitals' operational performance (e.g., Bhattacherjee et al. 2007) and financial performance (e.g., Setia et al. 2011; Sharma et al. 2016).

Although the majority of these studies focus on a single HIT, we argue that it is not a single technology but a rich composite of technologies supporting a hospital's various functions and processes that gives the hospital a competitive advantage. Clearly, adopting a composite of technologies does not automatically lead to superior hospital performance. Our conceptualization of digital advantage is based on the logic of digital options, which are a set of strategic IT-enabled capabilities in the form of process capital and knowledge capital (Sambamurthy et al. 2003). As Sambamurthy et al. (2003) state, "digital options develop through an iterative learning process of integrating information technologies with business processes and knowledge" (p. 253). They describe digitized process capital as IT-enabled interorganizational and intra-organizational work processes that integrate a firm's activities by providing a seamless flow of activities and information (process reach) while providing quality information about the performance of the process and transparency of this information to other systems or processes that need it (process richness). They describe digitized knowledge capital as both the IT-enabled knowledge repository and systems that enable employees to share their knowledge (knowledge reach) as well as systems of interaction for sense-making (knowledge richness). Clearly, the higher an organization's stock of IT, the more opportunities for leveraging IT to expand the reach and richness of its business processes and knowledge systems. As such, a hospital's stock of HITs is viewed as a digital options generator: when opportunities arise, a hospital's stock of HITs allows the hospital to strengthen its processes and knowledge systems to achieve superior performance, especially when the hospital's stock of HITs includes technologies that are not widely diffused.

Consider the following example of how a composite of HITs can generate greater advantage than each HIT used alone. Electronic medical record (EMR) systems systematically collect and manage a wide range of patient health and clinical data (e.g., patient and diagnostic information, prescriptions, and lab results). However, many clinical activities (e.g., diagnoses and treatments) involve not only extensive information management but also complex care coordination, communication, and decision making across providers. Hence, EMR adoption is ideally accompanied by computerized provider order entry (CPOE) to facilitate cross-provider care coordination and communication (McCullough et al. 2016). CPOE allows physicians to electronically enter orders for services and medications. Because of the direct order entry, CPOE reduces opportunities for miscommunication between different care providers. Clinical technologies such as electronic medication administration records (eMAR) and picture archiving communications systems (PACS) can further extend the effective reach of EMR and CPOE systems, facilitating communications across disparate components of a medical team. Specifically, eMAR closes the loop in medication ordering and dispensing by connecting pharmacists to nurses. PACS facilitates communications with radiologists, improving the speed and quality of radiology test results. Therefore, adopting CPOE, eMAR, and PACS in conjunction with EMR (i.e., a greater stock of HITs) creates digital advantage in that it gives a hospital the "digital options" to strengthen the quality of information generated in the processes of patient care, the transparency of information from one process to others, and the efficiency of information flow across different hospital functions, which all serve to improve hospital performance. Furthermore, the rarer the use of these technologies among competing hospitals, the more comparative advantage these digital options can potentially confer to the hospital.

Another example of a composite of technologies generating digital options is the adoption of radio frequency identification (RFID) together with EMR and supply chain management systems (e.g., inventory, equipment, and pharmacy management systems) (Pasupathy and Hellmich 2015). Hospitals that adopt these technologies can issue RFID-enabled tags, which not only track the movement and location of patients, staff, and inventory (e.g., medications) but also link them to patient EMR data. For example, when clinical staff is attending to patients, RFID tags can automatically authenticate clinical staff into the EMR system and connect them to the patients' medical records. Because these technologies can track important devices and medications used on the patients, they can also identify the clinical staff who used the devices and administered the medications. This reduces medical errors, improves patient safety, and allows the hospital to manage the medical equipment more efficiently (e.g., medical devices can be easily located and returned to their correct place after use). Therefore, collectively adopting these technologies gives a hospital the digital options to streamline the processes of patient care and integrate patient-related processes with the processes of supply chain management, enhancing the organization's digital process reach and richness. These can potentially improve patient experiences and lower hospital costs.

Furthermore, with a stock of HITs, a hospital is better positioned to seize emergent opportunities by combining different technologies and other resources to make strategic moves and exploit the opportunities. For example, Porter and Lee (2013) propose a strategic agenda that aims to help hospitals improve medical outcomes, efficiency, and market share. At the core of this strategic agenda is a shift from a supply-driven healthcare system organized around specialty departments and discrete services to a patient-centered system organized by integrated practice units—that is, teams comprised of both clinical and nonclinical personnel providing the full care cycle for a patient's condition (e.g., hospitalization, outpatient visits, testing, physical therapy, and other interventions). The technologies discussed in the above examples enable such strategic moves since they increase the degree to which information flows across different care providers and nonmedical personnel, the quality of information collected in the processes, and the ability to use the information to adapt the processes. Therefore, we suggest that digital advantage reflected in the stock of HITs weighted by their rareness can lead to advantages in medical outcomes and organizational efficiency by generating digital options that enable strategic moves in response to competitors' actions or market opportunities.

Having conceptualized digital advantage and highlighted its importance to hospital performance through the generation of digital options, we turn our attention to identifying its antecedents, which is the focus of the current study. Figure 1 shows the conceptual model for our study where we provide an integrative framework of digital advantage's antecedents and effect on hospital performance by linking the logic of digital options and Bourdieu's (1986) conceptualization of capital. We use the latter to identify and organize the various factors that affect digital advantage, which we describe next.

Bourdieu's Forms of Capital

Bourdieu (1989) suggests that "the distributions of agents in social space are dependent upon the volume and structure of capital they possess" (p. 17). Bourdieu identified different forms of capital—*cultural, social,* and *economic* being the most important—that are unequally distributed across social actors (Swartz 2002). *Cultural capital* refers to a social actor's knowledge, skills, experiences, qualifications, and credentials (Bourdieu 1991). *Social capital* refers to the resources that stem from the social actor's networks and acquaintances (Everett 2002). *Economic capital* refers to the monetary and material wealth held by a social actor (Everett 2002).

Bourdieu's theory can be used at both the individual and organizational levels (Özbilgin and Tatli 2005). At the organizational level, organizations are typically treated as "social actors" and the institutional or organizational context is conceptualized as a field structured in forms of unequally distributed capital. Conflict and competition characterize the relationships between the organizations in the field as they try to accumulate, conserve, or convert different forms of capital (e.g., Gomez 2010; Moingeon and Ramanantsoa 1997; Oakes et al. 1998). For example, Gomez (2010) theorized how organizations can develop strategies to accumulate capital that allows them to gain power and improve their competitive situation. The majority of organizational studies leveraging Bourdieu's framework focuses on his concept of "capital." Among the various forms of capital, a recent literature review (Sieweke 2014) shows that social capital is by far the most frequently employed (70 out of 90 reviewed papers, or 47.2%), followed by cultural capital (18.2%) and economic capital (12.8%).[4]

Given that Bourdieu's theory focuses on how the distribution of various forms of capital across social actors allows them to improve their position in their competitive environment, and digital advantage describes how firms accumulate technology stock to generate digital options and improve their competitive position, the examination of cultural, structural, and economic capital is well-suited to explain how the possession of various forms of capital by a hospital influences its digital

[4]There is also an expansion in the forms of capital in organizational studies, including intellectual (Stewart 1997), emotional (Thomson 2001), and relational capital (Kyriakidou and Özbilgin 2006). The expanded set of capital has been used to explain organizational capabilities (e.g., Subramaniam and Youndt 2005), competitive advantage (Nahapiet and Ghoshal 1998), and interorganizational linkage (Chung et al. 2000). Despite the increasing use of capital, the literature does not draw together and amalgamate the different forms of capital in an overarching framework (Özbilgin and Tatli 2005).

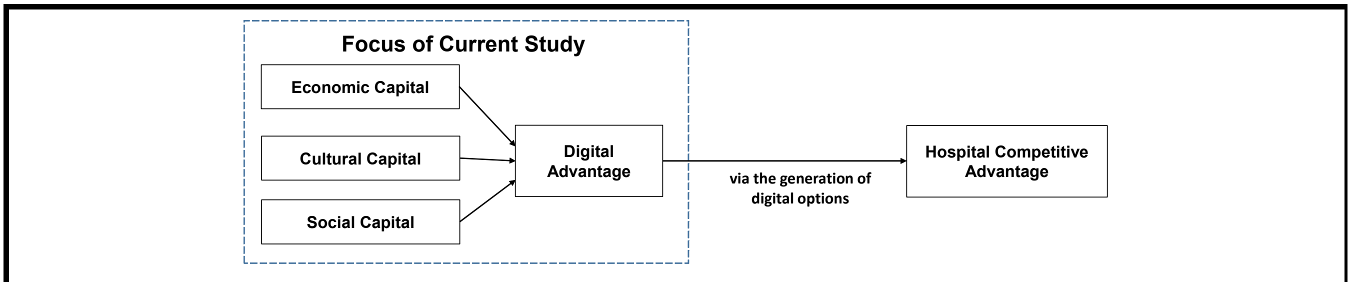

Figure 1. Conceptual Model of Digital Advantage

advantage and its ability to generate digital options to enhance hospital performance.

In addition to examining the main effects of cultural, structural, and economic capital, we also examine substitutive and complementary effects between these. Bourdieu suggested that *over time* one form of capital could be converted to other forms. For example, in the long run, monetary wealth (i.e., economic capital) can be slowly converted into knowledge and qualifications (i.e., cultural capital) through education and training (Bourdieu 1986). Also, by displaying cultural capital, a social actor can gain acceptance and status in a field, which leads to the acquisition of social capital in the long run (Bourdieu 1986). Social capital can provide a social actor with more opportunities to succeed. Therefore, a social actor with greater social capital is more likely to obtain economic capital in the long run, which can be reinvested in cultural capital (Bourdieu 1986). The substitutive and complementary effects examined in this research are different from the conversion between the different forms of capital suggested by Bourdieu (Bourdieu and Wacquant 1992). Instead of looking at the long-term conversion and transformation between different forms of capital, we theorize that, to some extent, certain forms of capital can substitute for or complement other forms of capital *at a given point of time*. For example, when a hospital does not have the economic capital to experiment with a new HIT, it may obtain knowledge about the HIT (e.g., potential benefits and pitfalls of the HIT, implementation know-how, etc.) through its social network. Furthermore, different forms of capital may also work synergistically to affect digital advantage. For instance, knowledge obtained through knowledge spillover due to geographical proximity can be complemented by more in-depth knowledge about HITs shared through institutional arrangements. Therefore, theorizing substitutive and complementary effects of different forms of capital at a given point of time can provide a more holistic view of how different forms of capital can be leveraged to improve digital advantage.

Theorizing hospital digital advantage, which involves the accumulation of HIT stock, requires identifying the factors that determine the adoption of an *array* of HITs by hospitals. To this end, a systematic review of the organizational IT adoption literature as well as the hospital IT adoption literature can provide insights into factors that influence adoption but are *not idiosyncratic* to a *specific technology* and are instead systemic (i.e., generalizable across a variety of innovations). We map these factors to Bourdieu's forms of capital and show that Bourdieu's theory is an effective structure to organize the disparate factors emerging from our review. Below we present a literature review of organizational IT adoption both in general and in the specific context of hospitals.

Organizational IT Adoption

Our review of the organizational IT adoption literature (see Appendix A) lends credence to using Bourdieu's theory to identify the antecedents of digital advantage. Specifically, our review points to cultural capital (in the form of internal knowledge resources), social capital (in the form of external knowledge resources), and economic capital (financial resources) as significant *systemic* (i.e., non-innovation specific) factors influencing IT adoption. We next review nonhospital organizational IT adoption studies and then focus our attention on hospital IT adoption studies.

Internal knowledge-related factors representing cultural capital are important predictors of organizational IT adoption in 38 of the 53 organizational IT adoption studies (72%). For example, IT sophistication (e.g., Chwelos et al. 2001; Khoumbati et al. 2006; Mishra and Agarwal 2009; Rai et al. 2009; Raymond 1990), IT experience (e.g., Bretschneider and Wittmer 1993; Chatterjee et al. 2002; Iskandar et al. 2001; Zhu et al. 2006), absorptive capacity (e.g., Chengalur-Smith et al. 2010; Liang et al. 2007), and integrated information delivery structures (Kettinger et al. 2013) are all types of cultural capital held internally within an organization that have been included as predictors in organizational IT adoption studies. *External knowledge-related factors representing social capital* have been included in 11 of 53 organizational

IT adoption studies (21%). These include network connections (e.g., Bharati and Chaudhury 2010; Montazemi et al. 2008), interorganizational links (Pennings and Harianto 1992), knowledge sharing with vendors (Ravichandran 2005), and learning spillovers (Baird et al. 2012). Finally, *economic capital*, such as organizational size (e.g., Bajwa et al. 2008; Chengalur-Smith et al. 2010; Khoumbati et al. 2006), slack resources (e.g., Grover et al. 1997; Li et al. 2011), and financial readiness/resources (e.g., Hsu et al. 2012; Rai et al. 2009), is included as a determinant of organizational IT adoption in 43 of the 53 studies reviewed (81%), which indicates the importance of economic capital as a key determinant of adoption across ITs in organizations.[5]

Hence, the systematic review reveals that (1) economic and cultural capital are commonly included in organizational IT adoption studies, but social capital is relatively understudied; (2) only seven of the 53 studies include all three forms of capital and four of these studies treat economic capital as a control variable; (3) none of these studies accounts for substitutive or complementary effects between the three forms of capital; and (4) only five of the 53 studies (Bajwa et al. 2008; Bharati and Chaudhury 2010; Fichman 2001; Grover and Goslar 1993; Rai et al. 2009) examine the adoption of a composite of multiple (ranging from 3 to 15) technologies, and of these five, only Bharati and Chaudhury (2010) included all three forms of capital, albeit economic capital (measured as organization size) was treated as a control. Therefore, the existing literature has not taken a comprehensive approach to examining the various forms of capital and their interactions in the context of accumulating a stock of IT.

Hospital HIT Adoption

Our review of hospital IT adoption studies identifies 22 studies shown in Appendix A. Similar to organizational IT adoption studies, the most commonly included factor is economic capital (in 20 of 22 studies), most frequently captured as hospital size (e.g., Adler-Milstein, DesRoches et al. 2014; Angst et al. 2010; Burke et al. 2002; Cutler et al. 2005; Diana et al. 2014; Furukawa et al. 2008), but also as group purchasing arrangements (Gabriel et al. 2014), financial resources (Menachemi et al. 2005), operating revenue and cash flow (Wang et al. 2005), and slack resources (Jaana et al. 2006). Social capital is included in 13 of the 22 studies primarily in the form of system affiliation (e.g., Adler-Milstein, Kvedar, and Bates 2014; Burke et al. 2002; Diana et al. 2014; Furukawa et al. 2008; Gabriel et al. 2014; Jaana et al. 2006; Wang et al. 2005), but also as geographic concentration (Wang et al. 2005) and social proximity (e.g., Angst et al. 2010). Cultural capital is the least common form of capital, included in only five of the 22 studies as IS knowledge, innovation of executives, and knowledge management capabilities (Hung et al. 2010); IT leadership resources and technical leadership resources (Jaana et al. 2006); absorptive capacity (Peng et al. 2014); and job tenure and educational level (Kimberly and Evanisko 1981). Only one of the 22 studies, Jaana et al. (2006), theorized the impact of all three forms of capital on hospital HIT adoption. Finally, none of the studies account for substitutive or complementary effects between all three forms of capital, although Peng et al. (2014) examined the substitutive effect between cultural capital and social capital in influencing hospital adoption of a single clinical technology.

Five[6] studies examined hospital adoption of a composite of *multiple* HITs (Burke et al. 2002; Furukawa et al. 2008; Jaana et al. 2006; Wang et al. 2005; Zhang et al. 2013), which more closely aligns with our focus on digital advantage. The reported number of HITs examined ranges from 7 to 52 HITs. Some studies group the multiple HITs into three categories (i.e., administrative, clinical, and strategic) (Burke et al. 2002; Wang et al. 2005; Zhang et al. 2013), while others only study clinical HITs (Furukawa et al. 2008; Jaana et al. 2006). Adoption of multiple HITs is typically measured as a count variable (Furukawa et al. 2008; Wang et al. 2005; Zhang et al. 2013) or a percentage of the total number of applications (Burke et al. 2002). These studies reveal that aggregate HIT adoption is associated with a variety of factors, such as hospital size and operating revenue (economic capital), system membership (social capital), market factors (e.g., competition and HMO penetration), and hospital characteristics (e.g., teaching status, urban location, and accreditation status). Although the studies provide insights into the factors that influence the adoption of multiple HITs, with few exceptions (e.g., Janna et al. 2006; Wang et al. 2005), most are atheoretical.

[5]The systematic review also reveals factors other than economic capital and knowledge resources (cultural and social capital) that impact organizational IT adoption. For instance, *innovation-specific* factors (e.g., perceived benefits, costs, relative advantage) are specified in 28 out of the 53 studies (53%), and environmental factors (e.g., coercive, mimetic, and normative pressures) are included in 33 of the 53 studies (62%). Furthermore, organizational leadership factors (e.g., top management support for the specific innovation) and industry-related factors (e.g., sector, industry type) account for 38 of the 53 studies (72%). While these various factors play a role in shaping organizational adoption of ITs, they are idiosyncratic to the specific technology studied and may not apply to a portfolio of ITs across a number of organizations. Moreover, because we are studying a specific industry, the healthcare industry, the industry-related factors remain constant in our context.

[6]Three other studies, Gabriel et al. (2014), McCullough (2008), and Menachemi et al. (2005), also examined multiple HITs but assessed the adoption of each HIT *separately* and report differences in adoption antecedents by each HIT examined.

While Jaana et al. (2006) focuses both on hospital adoption of multiple HITs and examines antecedents that fall into all three forms of capital as identified in our study, the 19 HITs they study are solely clinical and are not differentiated based on how widely diffused they are. Furthermore, the study assesses only direct effects but does not consider substitutive or complementary effects between different forms of capital in influencing adoption of a portfolio of HITs.

We suggest that based on Bourdieu's forms of capital, we can classify antecedent factors from prior research at a higher level of abstraction, identify new factors, and infer the importance of various types of factors as well as how they substitute or complement each other. Moreover, it is clear from the table in Appendix A that the existing studies have focused on only some forms of capital (most notably, economic capital and some aspects of social capital) and, with the exception of Jaana et al. (2006) and Wang et al. (2005), have used single indicators for most. Therefore, there is a need for (1) a richer conceptualization of different types of capital using multiple indicators, (2) the inclusion of all types of capital to assess their relative importance, and (3) an exploration of complementary or substitutive effects across types of capital so that hospitals lacking in one may be able to leverage another for advantage or gain synergies across types. Furthermore, the four studies that assess the adoption of multiple HITs with an aggregate measure treat all HITs indiscriminately, without differentiating the technologies based on their extent of diffusion. Once a technology is commonly adopted and best practices have diffused, it is less likely to enable the hospital to further improve its processes and knowledge systems above and beyond existing practices of competitors who also have the technology. In measuring digital advantage, our study takes into consideration how commonly adopted each HIT is. Finally, prior research is skewed toward the study of clinical HITs, leaving investigation of administrative (business) HITs widely unexplored (Mindel and Mathiassen 2015). Our study aims to address these identified gaps.

Hypotheses Development

Cultural Capital

Following Bourdieu (1991), we define cultural capital as the knowledge, skills, capabilities, and direct experiences with HITs held by the hospital's IT personnel. Cultural capital for digital advantage includes current know-how related to the technical aspects of both hardware and software, the capabilities to develop or experiment with HITs to create digital options, and the effective management of HIT projects. Additionally, cultural capital reflects the knowledge of how various HITs fit the needs and priorities of the hospital, how they can be integrated to create complementarities and improve business and clinical processes (i.e., the creation of digital options), and how the culture and routines of the hospital will affect the utilization of HITs (Bharadwaj 2000; Ravichandran 2005; Wade and Hulland 2004).

Cultural capital is particularly important to digital advantage because there are substantial knowledge barriers (project, technological, and organizational) associated with adopting and using HITs and with leveraging HITs to design effective, efficient, and innovative processes and services, that is, to generate digital options (Sambamurthy et al. 2003). Project-related knowledge barriers relate to shortcomings in the knowledge needed to manage the overall HIT project and allocate resources to the project. Technological knowledge barriers involve a lack of requisite knowledge to make critical decisions about the selection of a technological infrastructure, hardware, software, and security. Organizational knowledge barriers reflect the difficulties of integrating a new HIT into existing practices and structures, redesigning organizational processes to leverage the HITs in order to extend process reach and richness, and learning how to adequately support regular use of the HIT (Paré and Trudel 2007). People with the right knowledge and an innovative mindset are more likely to see the strategic value of HITs, identify HIT-enabled opportunities, and conceive digital options. They also would be more willing to experiment with new HITs and processes and to utilize such resources in developing and executing competitive actions. Thus, we posit that higher cultural capital should lower the knowledge barriers necessary for adopting and using HITs, leading to a higher hospital digital advantage.

> ***H1**: There is a positive relationship between a hospital's cultural capital and its level of digital advantage.*

Social Capital

Social capital captures the benefits an organization receives from participating in communities and networks including information, support, guidance, and social contacts (Adler and Kwon 2002). Social capital benefits digital advantage by facilitating knowledge exchange between hospitals, thus enabling a hospital to acquire both explicit and tacit knowledge about the various HITs, their benefits, implementation know-how, and how to design new processes, routines, and services based on the stock of a hospital's HITs (Fichman and Kemerer 1997; Kettinger et al. 2013; Ravichandran 2005).

Social capital, embedded in interorganizational relationships, can significantly influence members' access to knowledge by reducing the psychological or physical distance across actors, thus enhancing opportunities for knowledge flow between organizations (Argote et al. 2003). In their study of EMR adoption, Angst et al. (2010) refer to the psychological distance as "social proximity" and the physical distance as "spatial proximity." Following this logic, we argue that social capital accrues not only through multihospital systems or information exchange networks (which serve to reduce "psychological distance" between organizations) but also through geographic proximity to other hospitals or medical institutions (which serves to reduce "physical distance" between organizations). Therefore, in this study, we differentiate between two forms of social capital that provide relevant knowledge for digital advantage: (1) social capital from institutional arrangements of belonging to a multihospital healthcare system and information exchange networks (termed *institutional-arrangement-based social capital)* that facilitates *intentional knowledge sharing* and (2) social capital derived from proximity to other hospitals and medical schools in the same geographical area (termed *geographic-proximity-based social capital)* that facilitates *unintentional knowledge spillover*.

Institutional-Arrangement-Based Social Capital

Approximately 55% of licensed hospitals belong to a multihospital system (Rosko and Mutter 2011). A multihospital system refers to two or more affiliated hospitals that are owned (fully or partly), leased, sponsored, or managed by a central organization (Granderson 2011). We argue that membership in such multihospital systems creates social capital for the participating hospitals, which facilitates knowledge exchange that benefits digital advantage and the generation of digital options.

The social network connections are greater within the same parent organization than across independent organizations (Tichy et al. 1979; Tushman 1977). This is because multiorganization groups often provide structures and incentives for regular member interactions and personal relationship development (Darr et al. 1995; Ingram and Simons 2002). Therefore, co-membership enhances opportunities for communication and knowledge exchange. Moreover, the connections between members and their motivation to share knowledge are enhanced "by sympathy between participants" (Ingram and Simons 2002, p. 1518) and camaraderie, which arise due to relational similarity and in-group biases (Tajfel 1982). With these connections, the commonality of language is greater within the same parent organization than across independent organizations, which facilitates the capacity of a member organization to assimilate and apply the knowledge from other member organizations (Tichy et al. 1979; Tushman 1977). The co-membership also increases awareness of what others know at co-member organizations so that members know where they can find relevant knowledge (Borgatti and Cross 2003; Ingram and Simons 2002). Thus, all parent organization members benefit from the technological knowledge acquired by the first adopting unit in the parent organization (Epple et al. 1996; Winter and Szulanski 2001), and transfer of knowledge is more likely to occur between comembers of a parent organization than across independent organizations (Baum and Ingram 1998; Darr et al. 1995). The higher the number of members in a parent organization, the greater the amount of knowledge that can be generated through member connections and the more opportunities for knowledge sharing due to the larger potential knowledge pool.[7]

Another important institutional arrangement that facilitates HIT knowledge sharing within a multihospital system is centralization of the IT governance structure. A centralized IT governance structure at the parent organization level allows for greater control of creating and disseminating IT standards throughout the multihospital system (Brown and Grant 2005). Furthermore, centralization of IT decision making enables standardization of organizational IT strategies and processes (Baird et al. 2014). This governance structure not only facilitates centralized knowledge sharing related to technical expertise and know-how about adopting, implementing, and exploiting HIT for improved outcomes but also procurement and business strategies that facilitate digital advantage (Gabriel et al. 2014).

While membership and centralization of IT governance in multihospital systems give access to knowledge stocks of hospitals sharing the same parent organization, participation in health information exchange networks allows access to knowledge stocks of other hospitals within the same information exchange network around initiatives of common interests. These networks consist of a number of healthcare organizations that elect to connect to one another through collaboration initiatives, such as regional health information organizations (RHIOs), which act as independent third parties to connect relevant stakeholders in order to share knowledge related to electronic health information exchange, or specialized HIT projects spearheaded by federal agencies, such

[7]Co-membership can potentially also hinder digital advantage. It can be argued that members who resist new HITs will prevent other members from adopting these HITs. However, the literature overwhelmingly suggests a positive influence.

as the Agency for Healthcare Research and Quality (AHRQ), to enable collaboration toward enhancing healthcare quality through HITs and improving access to and utilization of HITs (Adler-Milstein et al. 2007).

Thus, both multihospital systems and information exchange networks reflect social capital for the participating members, which facilitates knowledge exchange that can benefit HIT adoption and implementation. Further, this social capital enables hospitals to leverage complementarities in the hospital's stock of HITs to design new processes, routines, and services. Indeed, empirical evidence suggests that hospitals affiliated with a multihospital system are more likely to adopt new technologies (Goes and Park 1997; Green et al. 2015; Menachemi et al. 2005), and Angst et al. (2010) find that social proximity is associated with higher likelihood of adoption of EMRs. When a hospital adopts a new technology, it is likely that other hospitals in the same system or information exchange network/initiative will become aware of the technology soon thereafter. Social capital thus enables HIT diffusion to other hospitals in the same system or network and supports successful HIT assimilation because these interorganizational relationships become "efficient conduits for exchanges of technological capabilities and knowledge between hospitals" (Goes and Park 1997, p. 689). Thus, we posit

> ***H2***: *A hospital's institutional-arrangement-based social capital will be positively associated with the hospital's level of digital advantage.*

Geographic-Proximity-Based Social Capital

Social capital can also accrue through geographic proximity to other organizations, enabling knowledge spillovers, because colocated organizations are easily "connected" to each other through frequent social interactions, observations, and communications (e.g., Forman et al. 2005a, 2005b). Also, the pooled labor market and informal social interactions between employees of different organizations enhance the connections between the colocated organizations.

According to the knowledge externalities literature (e.g., Griliches 1957; Krugman 1991a), knowledge spillover refers to the unintentional transfer of knowledge produced by a firm's innovation efforts. That is, the firm does not deliberately engage in knowledge transfer; rather, knowledge is communicated to other firms (e.g., Howells 2002; Kaiser 2002) via, for example, social interaction and informal information sharing among its members or through personnel turnover.[8] Knowledge spillover among firms has been recognized as playing an important role in adoption and innovation (e.g., Berliant et al. 2006; Jaffe et al. 1993; Krugman 1991b).

Knowledge spillover between healthcare organizations may occur when employees of different hospitals informally interact with each other, leading to knowledge exchange. Different hospitals may hold different types of knowledge about HITs, may have implemented different HITs, may have had different implementation experiences with various HITs, or may have leveraged the stock of HITs in different ways to create digital options. As such, the knowledge held by each hospital is likely different; thus, the benefits of knowledge spillover will increase as the number of hospitals involved increases. In particular, greater amounts of knowledge can be obtained from external organizations that are seeking similar innovations (Jaffe 1986), from external organizations within the same industry (Henderson and Cockburn 1996), and from external academic institutions—given their lower incentive to hide their innovations for competitive gain (e.g., Alcácer and Chung 2007; Jaffe 1989).

Because the quality of knowledge is subject to distance-decay effects, the benefits of knowledge spillover are greater when hospitals are located in spatial proximity to each other (Fujita and Thisse 1996; Simmie 2002). There is evidence of geographic localization of knowledge flows across firms (e.g., Adams and Jaffe 1996; Almeida and Kogut 1997), particularly when the firms are within the same industry (Galliano and Roux 2008). Thus, hospitals in spatial concentrations of other knowledge-rich facilities benefit from knowledge spillovers (e.g., Angst et al. 2010; Baird et al. 2012). In the case of HIT knowledge spillover, knowledge-rich facilities include other hospitals and medical schools in the area.[9] The greater the digital advantage that these local medical facilities have and the higher their spatial concentration, the larger the potential knowledge stocks and the potential for knowledge spillovers. Thus, we posit

> ***H3***: *A hospital's geographic-proximity-based social capital will be positively associated with a hospital's level of digital advantage.*

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[8]There is a distinction between horizontal spillovers, those between firms of the same industry, and vertical spillovers, those between firms across industries (Van Der Panne 2004). Our discussion focuses on horizontal knowledge spillovers.

[9]Research on knowledge spillovers has shown the importance of academic institutions to knowledge spillovers (e.g., Jaffe 1989; Jaffe et al. 1993). Therefore, we also include medical schools as a potential source of localized knowledge spillovers.

Economic Capital

Economic capital refers to the monetary means that support IT procurement and maintenance (Hsieh et al. 2011) as well as IT human resources. Adoption and implementation of HITs involves significant expenditures both in terms of the initial investment as well as implementation, training, subsequent upgrades, ongoing costs of operation, and realization of the digital options created through complementarities across various HITs and business processes. Economic capital makes technologies more affordable to the organization; enables experimentation with and consideration of new technologies well in advance of dire need, competitive necessity, or government regulation; provides the slack to develop and realize digital options; allows for the acquisition of in-house or consulting expertise; facilitates implementation processes; and absorbs failures (Eveland and Tornatzky 1990; Grover et al. 1997; Rosner 1968). Thus, we posit

> ***H4**: There is a positive relationship between a hospital's economic capital and its level of digital advantage.*

Interaction Effects

Substitutive Effects of Economic Capital with Other Forms of Capital

Hospitals with greater economic capital have the resources to hire in-house talent or consulting expertise and to outsource system development and/or technical support. Thus, they are less constrained by existing cultural capital and less reliant on social capital to lower knowledge barriers to HIT adoption, implementation, and digital option generation. On the contrary, hospitals with less economic capital lack the resources to actively engage in experimentation with new technologies and take risks with new HITs, making cultural capital and social capital important sources of technical expertise and vicarious learning about new HITs and their benefits. Therefore, we posit the following substitutive interaction effects:

> ***H5**: Cultural capital will have a stronger effect on hospital digital advantage for hospitals with lower economic capital than for those with greater economic capital.*

> ***H6**: Institutional-arrangement-based social capital will have a stronger effect on hospital digital advantage for hospitals with lower economic capital than for those with greater economic capital.*

> ***H7**: Geographic-proximity-based social capital will have a stronger effect on hospital digital advantage for hospitals with lower economic capital than for those with greater economic capital.*

Substitutive Effects of Cultural Capital and Social Capital

Cultural capital represents hospitals' internal IT knowledge stocks, including up-to-date technical knowledge related to both hardware and software and the capabilities to manage HIT projects. Additionally, these internal knowledge stocks entail an understanding of how new HITs strategically align with the needs and priorities of the hospital, how they can be leveraged to generate digital options that extend the reach and richness of existing processes and knowledge systems, and how the culture and routines of the hospital will affect HIT utilization. Institutional-arrangement-based social capital, which facilitates knowledge sharing among hospitals in a multihospital system and among participants of health information exchange networks/initiatives, will likely be a source of technical expertise, know-how, and implementation advice (Goes and Park 1997). We expect a substitutive effect between cultural capital and institutional-arrangement-based social capital. This is because a hospital's external knowledge (e.g., expertise, know-how) derived from its multihospital system or information exchange networks will be less critical to enabling adoption, implementation, and digital options generation if these knowledge and skills already exist in the hospital. Thus, we posit

> ***H8**: Institutional-arrangement-based social capital will have a stronger effect on hospital digital advantage for hospitals with lower cultural capital than for those with greater cultural capital.*

Similarly, geographic-proximity-based social capital can, via knowledge spillovers, enhance hospitals' awareness of new HITs, potential benefits, and implementation pitfalls. However, if a hospital's internal technical knowledge and expertise (i.e., cultural capital) are high, such strong cultural capital increases its alertness to emerging technologies (Zaheer and Zaheer 1997), rendering the effect of geographically localized knowledge spillovers less critical to the adoption and use of HITs. Therefore, we posit

> ***H9**: Geographic-proximity-based social capital will have a stronger effect on hospital digital advantage for hospitals with lower cultural capital than for those with greater cultural capital.*

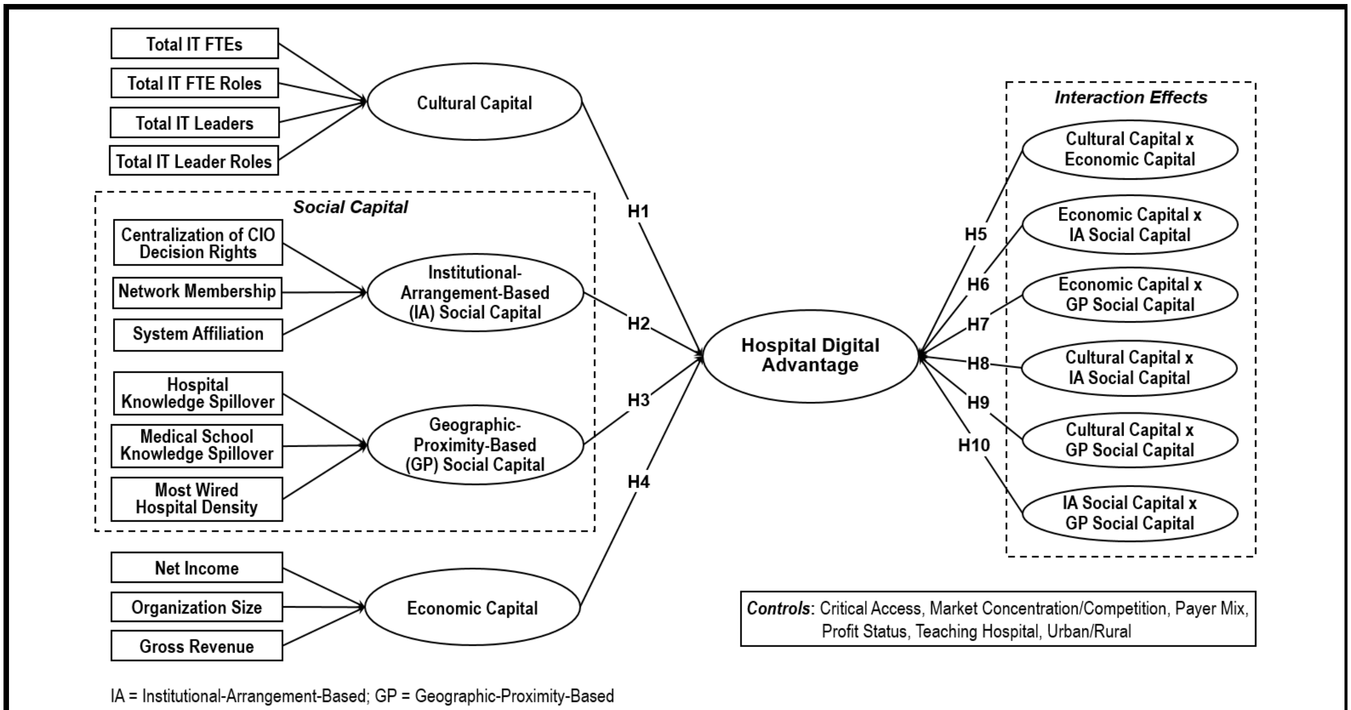


Figure 2. Research Model

Complementary Effects of the Two Types of Social Capital

We expect a complementary effect between institutional-arrangement-based social capital and geographic-proximity-based social capital. Although both types of social capital enable knowledge exchange and reduce the knowledge barriers to the adoption and use of HITs, the type of knowledge exchanged across the two mechanisms will likely differ. Knowledge spillovers based on geographic proximity will likely enhance hospitals' awareness of HITs, potential benefits, and implementation pitfalls. However, knowledge sharing through system affiliation with a multihospital system will likely be a source of technical expertise, know-how, and implementation advice (Goes and Park 1997). These institutional arrangements result in more intentional, systematic, and in-depth knowledge exchanges than unintentional knowledge spillover. When a hospital becomes aware of a new HIT and its potential benefits and implementation pitfalls through knowledge spillovers, the hospital can enrich its knowledge on the topic by synergistically exploiting the technical expertise and know-how obtained from its own multihospital system or information exchange networks. Thus, knowledge derived from both sources of social capital will synergistically combine, lowering knowledge barriers to adoption, use, and exploitation of various HITs to enhance hospital processes and systems.

> ***H10**: Complementarities between institutional-arrangement-based social capital and geographic-proximity-based social capital will be positively related to a hospital's level of digital advantage.*

Controls

Prior studies have identified other hospital-level variables that affect HIT adoption, which may also affect a hospital's digital advantage. We include the following as controls: whether the hospital is a critical access hospital (DesRoches et al. 2013), whether the hospital is located in an urban or rural area (Ward et al. 2006), the hospital's profit status (Angst et al. 2010), whether the hospital is a teaching hospital (Furukawa et al. 2008), competition among hospitals operating in the same geographic area (Baird et al. 2014), and the hospital's payer mix (i.e., the ratio of Medicare patient discharges to total patient discharges) (Furukawa et al. 2008; Zhang et al. 2013). Figure 2 summarizes our hypotheses.

Methodology

Data for the study were obtained from four major sources in the year 2007: the Healthcare Information and Management Systems Society (HIMSS) Analytics database, the American

Hospital Association (AHA) Annual Survey database, the American Hospital Directory (AHD) database, and the Centers for Medicare and Medicaid Services (CMS) public data sources. Medicare IDs were used to merge hospital data across sources, and hospital observations were matched based on their annual fiscal reporting periods. The HIMSS dataset contains adoption data for 90 HITs used by general medical and surgical hospitals (see Appendix C). Supplemental data were also obtained from the National Institute of Health (NIH) website and Hospitals & Health Networks (H&HN), an online publication of AHA. Table 1 summarizes the study's variables and indicates their sources. Our final dataset consists of 953 general medical and surgical hospitals in the southeastern United States (Louisiana, Mississippi, Tennessee, Alabama, Georgia, South Carolina, North Carolina, and Florida) (see Table 2 for sample characteristics). We limited our sample to only general medical and surgical hospitals because variation in the type of healthcare facility (e.g., ambulatory services, physician offices, pediatric hospitals) may influence the type and number of HITs adopted.

To measure digital advantage, the operationalization should capture both the number of HITs adopted and how rare these are in terms of their diffusion among hospitals. An appropriate aggregate index of technology for this purpose is the Saidin index (Spetz and Maiuro 2004). It is a weighted sum of the various applications, with each weight being the percent of hospitals that have *not* adopted the technology (Spetz and Maiuro 2004). Thus, weights of widely diffused HITs will be low while HITs that have not widely diffused will have higher weights. Examples of the most widely diffused HITs in our sample are accounts payable, general ledger, and patient billing, which were adopted by all 953 hospitals in our sample. Examples of the least diffused HITs are RFID supply tracking (adopted by 36 of the 953 hospitals) and RFID patient tracking (adopted by 87 of the 953 hospitals).

To calculate the index for hospital i, for each application indexed $k = 1, ..., K$, we assign a weight α_k, calculated by

$$\alpha_k = 1 - \tfrac{1}{N}\sum_{i=1}^{N}\tau_{ik}$$

where N is the total number of hospitals in the dataset and τ_{ik} takes the value of 1 if hospital i adopts application k and the value of 0 otherwise. The weights were used to calculate the Saidin index for hospital i:

$$S_i = \sum_{k=1}^{K}\alpha_k \tau_{ik}$$

A high Saidin index indicates that the hospital is digitally advantaged while a low Saidin index indicates that the hospital is digitally disadvantaged.

To check the validity of the Saidin index, we calculated the index for the 67 hospitals rated as the "most wired" hospitals by Hospitals & Health Networks (H&HN).[10] We expect the indices for the most wired hospitals to be significantly higher than those for the rest of the sample. Indeed, the t-test results shown in Table 3 confirm that this holds true across the composite scores for all HITs.

Independent Variables

Based on Jarvis et al. (2003),[11] we modeled the independent variables as formative composites.

Economic capital is a composite of three formative indicators that capture hospital financial resources: organization size, gross revenue, and net income. Organizational size is a common proxy for slack financial resources (e.g., Grover and Goslar 1993; Teo et al. 2003). Large organizations tend to have more resources and are more capable of absorbing the negative impact of adoption risks compared to smaller organizations (Hannan and McDowell 1984; Rogers 1995). As a result, small hospitals face more financial barriers to HIT adoption, implementation, and utilization than larger hospitals. We use number of staffed beds as our measure since it is the typical measure used in healthcare for organization size (e.g., Furukawa et al. 2008; Jha et al. 2009). Moreover, *ceteris paribus*, hospitals with greater revenue and profits are more likely to have the necessary economic capital for HIT adoption, implementation, and utilization. Therefore, we also include gross revenue per staffed bed and net income as indicators of economic capital.

When measuring the economic capital available to hospitals, it is important to consider the varying costs to treat patients across different hospitals. Case mix index captures the relative average cost for a hospital to treat patients based on the complexity or severity of illness present in the hospital's patients (Mendez et al. 2014). Holding the available financial

[10]The "most-wired" list contains both stand-alone hospitals and multihospital systems. Out of the 67 most-wired hospitals in our sample, only 3 were stand-alone hospitals. The remaining 64 were part of multihospital systems. For example, the Duke University Health System, listed as a most-wired hospital, includes four separate hospitals in our sample.

[11]Constructs are modeled formatively if the direction of causality is from the indicators to the construct, if the indicators are not interchangeable, and if the indicators do not necessarily covary (Jarvis et al. 2003). Our capital constructs meet these criteria.

Table 1. Data Sources and Operationalization of Constructs

Construct	Indicator	Operationalization	Source
Hospital Digital Advantage	Saidin Index	Calculated through the number of HITs weighted by extent of diffusion of HIT (Spetz and Maiuro 2004)	HIMSS
Economic Capital	Organization Size	Number of staffed beds adjusted by case mix index (Furukawa et al. 2008; Jha et al. 2009; Mendez et al. 2014)	AHA, CMS
	Gross Revenue	Gross revenue adjusted by number of staffed beds and case mix index (Menachemi et al. 2005; Mendez et al. 2014)	AHD, AHA, CMS
	Net Income	The total operating revenue minus the total operating expenses (Mendez et al. 2014; Wang et al. 2005)	AHD, AHA
Cultural Capital	Total IT FTEs (Full Time Equivalent)	Total number of hospital IT personnel (full time IT project managers, IT managers, programmers, IT operations staff, networking administrators, IT security staff) (Fichman 2001; Fichman and Kemerer 1997)	HIMSS
	Total IT FTE Roles	Total number of hospital IT roles (Fichman 2001; Fichman and Kemerer 1997)	HIMSS
	Total IT Leaders	Total number of hospital IT leaders (CIO, CTO, IT Director, IT Security Officer, HIM Director, PACS Administrator, Radiology Medical Director) (Jaana et al. 2006)	HIMSS
	Total IT Leader Roles	Total number of hospital IT leader roles filled (e.g., CIO, CTO; see above) (Jaana et al. 2006)	HIMSS
Institutional-Arrangement-Based Social Capital	System Affiliation	Number of healthcare entities in multihospital system (system size) (Adler-Milstein, Kvedar, and Bates 2014)	HIMSS
	Network Membership	Number of information exchange networks participated (Jaana et al. 2006)	HIMSS
	Centralization of CIO Decision Rights	Centralized versus decentralized IT decision rights: 1 = single CIO in the same multihospital system (centralized), 0 = otherwise (decentralized) (Baird et al. 2014)	HIMSS
Geographic-Proximity-Based Social Capital	Hospital Knowledge Spillover	Calculated through the knowledge spillover formula using general medical and surgical hospitals in a 50-mile radius (Kaiser 2002)	HIMSS, Google Map
	Most Wired[a] Hospital Density	Number of most wired hospitals in a 50-mile radius (Kaiser 2002)	H&HN, Google Map
	Medical School Knowledge Spillover	Calculated through the knowledge spillover formula using hospitals affiliated with medical schools in a 50-mile radius (Kaiser 2002)	NIH, Google Map
Control Variables	Urban/Rural	CBSA type, 1 = Urban, 0 = Rural (Ward et al. 2006)	AHA, CMS
	Market Concentration/ Competition	Calculated through Herfindahl-Hirschman Index (Baird et al. 2014)	HIMSS
	Profit Status	Hospital profit status, 1 = For profit, 0 = Nonprofit (Angst et al. 2010)	HIMSS
	Critical Access	Critical access hospital, 1 = Yes, 0 = No (DesRoches et al. 2013)	HIMSS
	Payer Mix	Ratio of the number of Medicare patient discharges to total patient discharges (Furukawa et al. 2008; Zhang et al. 2013)	CMS
	Teaching Hospital	Member of the Council of Teaching Hospitals and Health Systems, 1 = Member, 0 = Non-member (Furukawa et al. 2008)	AHA

HIMSS: Healthcare Information and Management Systems Society Analytics database; AHA: American Hospital Association Annual Survey database; AHD: American Hospital Directory database; CMS: Centers for Medicare and Medicaid Services; NIH: National Institutes of Health website; H&HN: Hospitals & Health Networks, an online publication of AHA; CIO: Chief Information Officer; CTO: Chief Technology Officer; HIM: Health Information Management; PACS: Picture Archiving and Communication System.

[a]Most wired hospitals are the hospitals with advanced HITs for business and clinical performance in health care delivery. These hospitals would more likely be emulated by other hospitals, and their actions would be more influential to non-adopters.

Table 2. Sample Characteristics

	Frequency	Percent		Frequency	Percent
State			**Hospital Affiliation**		
Louisiana	109	11.4	Stand Alone	107	11.2
Mississippi	91	9.5	System Affiliated	846	88.8
Tennessee	127	13.3	**Profit Status**		
Alabama	100	10.5	Not-for-profit	687	72.1
Florida	207	21.8	For-profit	266	27.9
Georgia	143	15.0	**Urban/Rural**		
South Carolina	62	6.5	Urban	750	78.7
North Carolina	114	12.0	Rural	203	21.3

Table 3. Saidin Index Validity Test: T-tests of Most Wired Versus Other Hospitals

		N	Mean (S.D.)	Mean Difference	P-Value
Saidin Index: Total HITs	Most Wired Hospitals	67	21.49 (6.93)	6.58	.00
	Others	886	14.91 (8.39)		

resources constant, a hospital that treats a mix of patients with greater complexity of illness or conditions may have fewer available financial resources for HIT adoption, implementation, and utilization. To adjust for the hospitals' varying costs to treat patients, we divided the number of staffed beds and gross revenue per staffed bed by the hospitals' case mix index. The net income indicator captures a hospital's total operating revenue minus its total operating costs. Because this measure already takes into account costs, it was not adjusted by case mix index in our data analysis.

Cultural capital captures a hospital's internal knowledge stock including technical knowledge related to both hardware and software and knowledge of how to align HITs with the hospital's needs and priorities. The internal knowledge stock resides in the hospital's IT personnel. To measure cultural capital, we used four indicators including the total number of IT personnel in the hospital (e.g., IT managers, IT security staff, network administrators, programmers, etc.), the total number of hospital IT leaders (e.g., CIO, IT director, IT security officer, HIM director, etc.), the total number of hospital IT roles filled by IT personnel, and the total number of hospital IT roles filled by IT leaders. By measuring the number of IT staff and the number of IT roles, we capture the breadth and depth, respectively, of technical knowledge. Further, by including both IT personnel and IT leaders, we capture both operational and strategic IT knowledge.

Institutional-arrangement-based social capital, which facilitates intentional knowledge sharing, was measured through the size of the multihospital system with which a hospital is affiliated (i.e., the total number of healthcare provider facilities within a hospital's parent organization), the multihospital system's IT governance structure (i.e., centralized versus decentralized CIO decision rights), and the participation in information exchange initiatives.

Although prior research has used a binary measure (affiliated or not) of multihospital system affiliation (e.g., Goes and Park 1997), a measure that takes into account the number of other healthcare provider facilities belonging to the system is a better reflection of the potential for knowledge sharing.[12] We also developed an indicator of the multihospital system's IT governance structure by determining whether multiple CIOs exist in a parent organization, indicating a decentralized CIO decision rights structure, or a single CIO exists within a multihospital system, indicating an institutional structure of centralized IT decision rights (Baird et al. 2014). A centralized IT governance structure encourages more coordination and collaboration and, thus, more knowledge sharing than a decentralized IT governance structure. Stand-alone hospitals were treated as decentralized in their decision rights structure to indicate an absence of an institutional structure conducive to knowledge sharing.

While the first two measures capture institutional arrangements within a parent organization, the third measure is externally focused and captures participation in information

[12]For stand-alone hospitals, the size of system affiliation is one.

exchange initiatives (HIE). HIE members may include hospitals, clinics, medical societies, and major employers and payers, who follow a shared vision and governance structure, agree on a set of standards for data exchange, and adopt a technology infrastructure for data integration. Therefore, we consider HIE as an institutionalized approach to knowledge transfer, as participation in such a network may motivate members to adopt a specific technology or network infrastructure. Further, the development of an HIE involves participation by IT staff as well as medical providers, patient representatives, administrators, payer organizations, etc. This provides a forum for interaction and knowledge transfer. Two information exchange initiatives were included in this study: (1) HIT projects by the Agency for Healthcare Research and Quality and (2) Health Information Exchange/RHIO initiative. According to information on the Information Exchange Initiatives' website, the Agency for Healthcare Research and Quality "seeks to support efforts to develop, adopt, implement, and evaluate the use of health information technology (IT) to improve health care decision making" and RHIOs assist "affiliated providers with health IT adoption at the institutional level." Both of these information exchange initiatives are institutional arrangements that afford opportunities for knowledge sharing among the participants. Therefore, we created a categorical indicator to measure hospitals' participation in these information exchange initiatives (0 = not participating; 1 = participating in one; 2 = participating in both).

***Geographic-proximity-based social capital**,* which facilitates knowledge spillover, was measured through three formative indicators: hospital knowledge spillover, medical school knowledge spillover, and the number of most wired hospitals within a 50-mile radius from each hospital. Our measure of knowledge spillover is an attempt to isolate the effects of knowledge spillover from the effects of other locational externalities that may be present. Given that knowledge spillovers are invisible (Krugman 1991b), different proxies have been used to measure them. We use one technique suggested by Kaiser (2002) who tested the validity of four different methods of measuring knowledge spillovers. For any hospital i, hospital knowledge spillover within its geographic region (we used a 50-mile radius from the focal hospital) is measured by

$$S_i = \sum_{j \neq i}^{N} \omega_{ok} K_j$$

where K_j denotes Hospital j's stock of knowledge (i.e., their level of adoption of HIT) and ω_{ij} denotes the inverse of the geographic distance between the focal hospital i and hospital j. The sum over all hospitals (excluding the focal hospital) represents the knowledge spillover pool for hospital i in the 50-mile radius[13] geographic area that surrounds it (Jaffe 1986). The medical school knowledge spillover measure was calculated in a similar manner but instead of including hospitals, the measure included all of the medical schools within a 50-mile radius from the focal hospital.

We chose to use a different measure of knowledge spillover for the most wired hospitals (as identified by Hospitals & Health Networks, or H&HN). When calculating the hospital knowledge spillover measure, we excluded the most wired hospitals from our list of hospitals within a 50-mile radius. Therefore, we used the number of the "most wired" hospitals within a 50-mile radius from the focal hospital to calculate a separate measure of knowledge spillover effect (i.e., knowledge spillover from the most wired hospitals). This separate measure is necessary because the most wired hospitals are recognized for their extensive digitization so that they may have additional spillover effects on hospitals in their geographic region due to the extensive scope and depth of their HIT experience.

Calculation of each of the knowledge spillover indicators required that the distance between a focal hospital and all other hospitals in our dataset be determined and that hospitals in a 50-mile radius from the focal hospital be identified and included in the calculations of spillover measures. We obtained the address of each hospital in our dataset from the HIMSS database, the addresses of the most wired hospitals from H&HN, and the addresses of medical schools from the NIH website. Using the Google Map's database and these addresses, we obtained pairwise distances between all hospitals (and medical schools) and used these in the formula.

Control variables. We created a binary variable from the HIMSS dataset to indicate whether a hospital is a critical access hospital (1 = yes, 0 = no). For the urban versus rural location control variable, we used a binary variable from the AHA dataset that indicates whether a hospital is located in an urban or a rural area (1 = urban, 0 = rural). Using the HIMSS dataset, we calculated the Herfindahl-Hirschman Index (HHI) to control for the competition among hospitals operating in the same core-based statistical area (CBSA). We created a dummy variable from the HIMSS dataset to control for a hospital's profit status (1 = for-profit, 0 = nonprofit). To control for a hospital's payer mix, we used CMS data to calculate the ratio of the number of Medicare patient discharges to total patient discharges. Also, we included the hospital's teaching status as a control variable. Teaching status was measured by whether a hospital is a member of the Council of Teaching Hospitals and Health Systems, derived from the AHA dataset.

[13]We tested the robustness of our results by calculating 30-mile radius measures. Results remain essentially the same.

Data Analysis

We used SmartPLS with a 5,000 sample bootstrapping technique to assess our structural model. We also performed our analyses using multiple regression with our results staying substantively unchanged. Since our exogenous constructs are formatively measured, we used the two-step procedure suggested by Henseler and Chin (2010) to model interactions. We first ran a main-effects model to obtain the latent variable scores for all constructs and cross-multiplied these scores to create product terms; each product term was used as a single indicator for the interaction latent variable.[14]

Because multicollinearity is a concern for formative indicators (Diamantopoulos and Winklhofer 2001; Petter et al. 2007) and since cultural capital, economic capital, institutional-arrangement-based social capital, and geographic-proximity-based social capital are formatively measured, we examined variance inflation factors (VIF) to assess whether any exceeds 3.3 as recommended by Diamantopoulos and Siguaw (2006) and Petter et al. (2007). The maximum VIF is 2.48, indicating that multicollinearity is not an issue. To further validate our formative measures, we examined their weights (see Figure 3). With the exception of total IT leadership roles (T-statistic for weight = 1.18), all other formative indicators have significant weights on their corresponding constructs. We investigated the nonsignificant weight by examining the absolute (loading) significance of the indicator on its respective construct as suggested by Cenfetelli and Bassellier (2009). The loading for number of HIT leadership roles was significant (loading = .75; T-statistic = 14.57), suggesting that the number of HIT leadership roles is an important aspect of cultural capital in an absolute sense but not relatively important in the presence of the other indicators. It should, therefore, be retained as a measure for cultural capital.

An additional consideration in formative measurement is interpretational confounding.[15] To examine this, we ran the model with other dependent variables. When we replaced the Saidin index with the number of HITs adopted by each hospital, the weights and significance patterns for the formative dimensions remained essentially the same, thus alleviating concerns of interpretational confounding (Bagozzi 2011; Cenfetelli and Bassellier 2009; Kim et al. 2010). Finally, we ran disaggregated models where one formative construct at a time was decomposed and its indicators were direct antecedents of the dependent variable. The indicator with the nonsignificant weight, total IT leadership roles, had a nonsignificant path to the dependent variable (and those with significant weights had significant paths to the dependent variable, with one exception of most wired hospital density) alleviating the concerns of external consistency[16] (Kim et al. 2010). Table 4 presents the inter-construct correlations.

As shown in Table 5 and Figure 3, the results provide strong support for the hypothesized main effect relationships. Cultural capital (H1), institutional-arrangement-based social capital (H2), geographic-proximity-based social capital (H3), economic capital (H4), and two control variables—critical access and profit status—are all significant determinants of digital advantage, explaining 57.4% of the variance. Of these, institutional-arrangement-based social capital has the strongest effect on hospital digital advantage in the main effects model (a path coefficient comparison with economic capital shows significant differences [T-Statistic = 4.99]). In the interaction effects model,[17] institutional-arrangement-based social capital and economic capital have the strongest effects on hospital digital advantage (a path coefficient comparison between the two shows no significant differences [T-Statistic=1.56] and a significant difference with the rest of the independent variables).

The interactions were tested following Aiken and West (1991). As hypothesized, economic capital has substitutive effects with cultural capital (H5), with institutional-arrangement-based social capital (H6), and with geographic-proximity-based social capital (H7). As can be seen in Figure 4, the positive effects of cultural capital, institutional-arrangement-based social capital, and geographic-proximity-based social capital on digital advantage are stronger when economic capital is low than when it is high, providing support for the hypothesized substitutive effects (negative coef-

[14] Henseler and Fassott (2010) suggest that doing the two-step approach in PLS may not be appropriate since the latent variable scores of the interacting constructs may change when the interaction term is introduced. In that case, the latent variable scores on which the interaction term is calculated and the latent variable scores of the constructs in the model may differ. They suggest a two-step approach where the construct scores obtained by running the main effects model in PLS are used in regression to test for interaction effects. We performed our analyses using both PLS and regression and, without exception, our results are robust. We also performed the entire analysis using solely multiple regression. Our results are robust.

[15] Interpretational confounding occurs when formative indicators drive the empirical meaning of a latent variable in a way that is in contrast to the intended meaning assigned to it by the researcher (see Kim et al. 2010).

[16] External consistency is whether the measures of a formative construct have similar relationships to the antecedents and consequences of the construct as those of the construct itself (Carver 1989). Lack of external consistency implies that a formative construct does not effectively mediate the effects of its indicators on the dependent constructs (see Kim et al. 2010).

[17] To calculate effect size of the interaction model, we compared the model with all six interaction terms (Model 3) with the model with only main effects (Model 2) and found a small size effect ($f^2 = 0.07$) (Gefen et al. 2011). We then conducted a pseudo F-test for the effect size. The effect size is significant at the .05 level ($F_{1, 943} = 64.12$), which suggests that the six interaction terms add significantly to the model's predictive power.

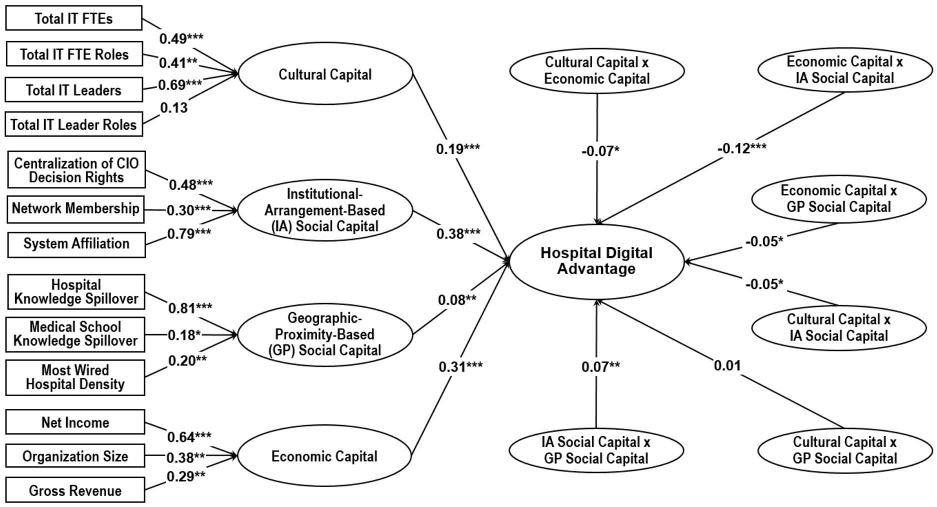
Table 4. Intercorrelations Among Latent Variables

	1	2	3	4	5	6	7	8	9	10	11
1. Hospital Digital Advantage	**1.00**										
2. Cultural Capital	0.48	**1.00**									
3. Economic Capital	0.54	0.42	**1.00**								
4. Institutional-Arrangement-Based Social Capital	0.53	0.21	0.37	**1.00**							
5. Geographic-Proximity-Based Social Capital	0.38	0.23	0.51	0.25	**1.00**						
6. Critical Access	-0.40	-0.27	-0.30	-0.32	-0.26	**1.00**					
7. Market Concentration/ Competition	0.16	0.20	0.10	0.07	-0.22	-0.22	**1.00**				
8. Payer Mix	-0.27	-0.20	-0.33	-0.13	-0.44	0.26	0.00	**1.00**			
9. Profit Status	-0.16	-0.17	0.04	0.26	0.01	-0.14	-0.02	0.01	**1.00**		
10. Teaching Hospital	0.18	0.23	0.35	0.11	0.34	-0.09	-0.04	-0.20	-0.11	**1.00**	
11. Urban/Rural	0.40	0.28	0.45	0.30	0.36	-0.37	0.43	-0.28	0.03	0.11	**1.00**

Table 5. Results

	Dependent Variable: Hospital Digital Advantage		
	Model 1	**Model 2**	**Model 3**
Controls			
Critical Access	**-0.30 *** (0.03)**	**-0.14 *** (0.03)**	**-0.13 *** (0.04)**
Market Concentration/Competition	-0.02 (0.03)	**0.04 * (0.03)**	0.02 (0.02)
Payer Mix	**-0.09 *** (0.03)**	-0.03 (0.02)	-0.02 (0.02)
Profit Status	**-0.20 *** (0.02)**	**-0.27 *** (0.02)**	**-0.28 *** (0.02)**
Teaching Hospital	**0.08 *** (0.02)**	**-0.07 ** (0.03)**	-0.03 (0.03)
Urban/Rural	**0.27 *** (0.03)**	0.03 (0.03)	-0.003 (0.03)
Main Effects			
Cultural Capital		**0.19 *** (0.03)**	**0.19 *** (0.03)**
Economic Capital		**0.23 *** (0.03)**	**0.31 *** (0.04)**
Institutional-Arrangement-Based (IA) Social Capital		**0.41 *** (0.02)**	**0.38 *** (0.02)**
Geographic-Proximity-Based (GP) Social Capital		**0.09 ** (0.03)**	**0.08 ** (0.03)**
Interaction Effects			
Cultural Capital × Economic Capital			**-0.07 * (0.03)**
Cultural Capital × IA Social Capital			**-0.05 * (0.03)**
Cultural Capital × GP Social Capital			0.01 (0.03)
Economic Capital × IA Social Capital			**-0.12 *** (0.03)**
Economic Capital × GP Social Capital			**-0.05 * (0.02)**
IA Social Capital × GP Social Capital			**0.07 ** (0.03)**
Adjusted R^2	0.295	0.574	0.601
Adjusted R^2 Difference		0.279	0.027

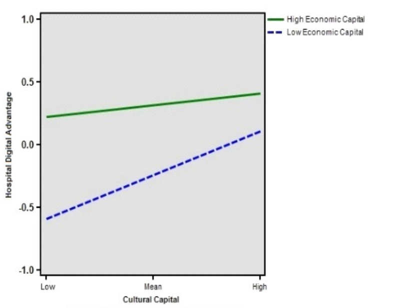
Standardized coefficients (standard errors) shown (one-tailed, given directional hypotheses); IA = Institutional-Arrangement-Based; GP = Geographic-Proximity-Based; *p < 0.05, ** p < 0.01, ***p < 0.001.



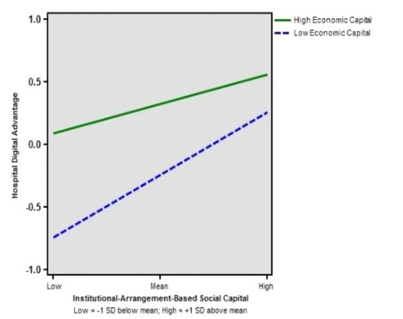
Controls:	Critical Access	Market Concentration/ Competition	Payer Mix	Profit Status	Teaching Hospital	Urban/Rural
Hospital Digital Advantage	-0.13***	0.02	-0.02	-0.28***	-0.03	-0.003

*p < 0.05, **p < 0.01, ***p < 0.001; IA = Institutional-Arrangement-Based; GP = Geographic-Proximity-Based

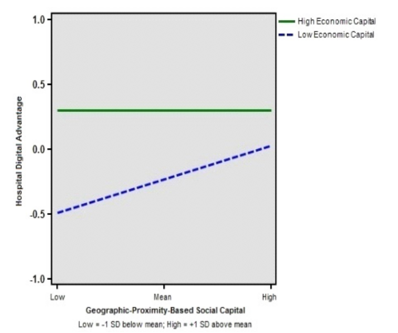
Figure 3. Results



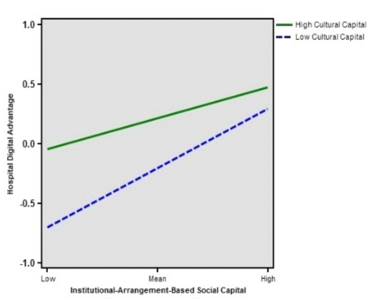
(a) Substitutive Effect of Economic Capital and Cultural Capital



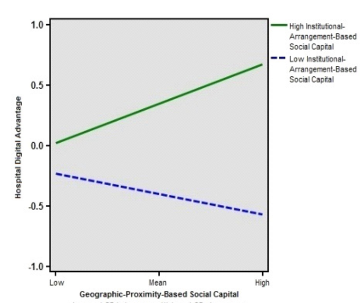
(b) Substitutive Effect of Economic Capital and Institutional-Arrangement-Based Social Capital



(c) Substitutive Effect of Economic Capital and Geographic-Proximity-Based Social Capital



(d) Substitutive Effect of Cultural Capital and Institutional-Arrangement-Based Social Capital



(e) Complementary Effect of Institutional-Arrangement-Based Social Capital and Geographic-Proximity-Based Social Capital

Figure 4. Interaction Plots

ficient for the interaction term). While all other simple slope tests are significant indicating significant effects at both low and high levels of economic capital, when economic capital is high, geographic-proximity-based social capital has no effect on digital advantage (the simple slope test at high economic capital for geographic-proximity-based social capital is nonsignificant [p-value of .998]). However, geographic-proximity-based social capital has a positive effect on digital advantage when economic capital is low. The results and interaction graphs also provide support for the substitutive interaction between cultural capital and institutional-arrangement-based social capital (H8); the positive effect of institutional-arrangement-based social capital on digital advantage is stronger for low cultural capital than for high cultural capital. However, the results provide no support for the substitutive interaction between cultural capital and geographic-proximity social capital (H9). Finally, the effect of geographic-proximity-based social capital on digital advantage is positive when institutional-arrangement-based social capital is high and is negative when institutional-arrangement-based social capital is low, supporting our hypothesized complementary effect (H10) (positive coefficient for the interaction term).

Robustness Tests

We performed several robustness tests. First, we ran our analyses in regression instead of PLS, and our results stayed qualitatively the same in terms of significance, direction, and relative magnitude of coefficients. Second, we performed several robustness tests on our dependent variable. Instead of the Saidin index, we used the count of HITs adopted. The results remained essentially the same for both the direct and moderating effects. We also used cluster analysis to classify hospitals into either a digitally advantaged group or a digitally disadvantaged group based on their Saidin index. We first used the hierarchical clustering method (Ward's minimum-variance method) to establish the number of clusters and cluster centroids and then used centroids as seeds in the nonhierarchical method (K-means). The tandem approach was recommended by other researchers (e.g., Caliński and Harabasz 1974; Punj and Steward 1983). One cluster contains digitally advantaged hospitals, and the other cluster contains digitally disadvantaged hospitals. Analysis using the cluster membership as the dependent variable yields similar results as presented in Figure 3 in terms of path coefficient significance.

Post Hoc Analysis for the Performance Impacts of Digital Advantage

Based on the logic of digital options, our conceptual model in Figure 1 suggests that a hospital's digital advantage enables the hospital to achieve superior performance by generating digital options. We conducted a *post hoc* analysis to provide preliminary evidence for this proposition.

Prior research has used *quality of care* and *financial performance* to assess hospital performance (Agarwal et al. 2010). In this *post hoc* analysis, we focus on *quality of care* given that quality of care is the most current standard for measuring hospital performance in the United States (Nerenz and Neil 2001; Schmaltz et al. 2011)[18] and to avoid endogeneity concerns given that financial capital is one of our independent variables. Further, because prices are administratively regulated, vigorous competition on quality of care is an important characteristic of the hospital competitive environment (Rivers and Glover 2008). We specifically examine if digital advantage predicts lower mortality and readmission rates, which are two major patient outcome metrics of quality of care examined in the literature (Agarwal et al. 2010).

We obtained mortality and readmission rates from the Hospital Compare Dataset provided by CMS. The dataset provides each hospital's risk-adjusted 30-day mortality and readmission rates for three conditions—heart attack, heart failure, and pneumonia—assessed every three years. We used the mortality and readmission data for the period 2008 to 2011, which is the three-year period following our study period. We constructed the overall mortality and readmission rates by taking the average of these rates for the three conditions and we regressed these on our measure of digital advantage and the control variables. As shown in Table 6, digital advantage is a significant predictor of lower mortality and readmission rates (negative relationship), providing preliminary evidence that digital advantage is consequential to hospital performance, at least as measured by quality of care.

Discussion

This research conceptualizes digital advantage as a hospital's technological edge relative to its competitors across a composite of technologies supporting the hospital's various functions and processes. By integrating Bourdieu's forms of capital and the logic of digital options, we develop an integrative conceptual framework of antecedents of digital advantage and explicate how digital advantage can translate to hospital performance through the creation of digital options. Specifically, we suggest that a hospital's HIT stock constitutes a

[18] These standards for measuring hospital performance have been set by The Joint Commission (TJC), which accredits over 80% of U.S. hospitals, and the Centers for Medicare and Medicaid Services (CMS). The standards exclude financial performance as part of a hospital's performance scorecard (Schmaltz et al. 2011).

Table 6. The Effect of Digital Advantage on Quality of Care

	Dependent Variable	
	Mortality Rate	**Readmission Rate**
Digital Advantage	**-0.02* (0.01)**	**-0.02* (0.01)**
Controls		
Critical Access	-0.43 (0.64)	**1.30* (0.76)**
Market Concentration/Competition	**0.0001*** (0.00002)**	**0.00005* (0.00002)**
Payer Mix	-0.03 (0.17)	**-0.55** (0.20)**
Profit Status	0.22 (0.12)	**0.66*** (0.13)**
Teaching Hospital	-0.19 (0.23)	**0.50* (0.23)**
Urban/Rural	**-0.54* (0.22)**	-0.59 (0.31)
Observations	556	474
Adjusted R^2	0.052	0.103

*p < 0.05, ** p < 0.01, ***p < 0.001.

digital options generator, which enables the hospital to achieve superior performance by combining and leveraging different technologies to design innovative processes, routines, and services. Focusing on the antecedents of digital advantage for our research model and hypotheses, we draw from Bourdieu's theory to examine the impact of a hospital's economic, cultural, and social capital (institutional-arrangement-based social capital and geographic-proximity-based social capital) on its digital advantage. In addition to main effects, we also examine substitutive and complementary effects between the different forms of capital.

The results of our analysis involving the adoption of 90 HITs across 953 hospitals provide support for our hypotheses. Economic capital ($\beta = .31$, p-value < .001), cultural capital ($\beta = .19$, p-value < .001), and two forms of social capital (institutional-arrangement-based social capital: $\beta = .38$, p-value < .001; geographic-proximity-based social capital: $\beta = .08$, p-value = <.01) have significant effects on hospital digital advantage. Of these, institutional-arrangement-based social capital and economic capital have significantly stronger effects, with the former having a significantly stronger effect than economic capital in the main effects model. This highlights the primacy of these two forms of capital for hospital digital advantage. The strong effect of institutional-arrangement-based social capital is likely because being affiliated with a multihospital system has knowledge sharing as well as economic benefits (e.g., economies of scale and purchasing power, etc.), both impacting digital advantage. Further, we found significant substitutive effects between cultural capital and economic capital ($\beta = -.07$, p-value = .02), between institutional-arrangement-based social capital and economic capital ($\beta = -.12$, p-value < .001), and between geographic-proximity-based social capital and economic capital ($\beta = -.05$, p-value = .02) on hospital digital advantage. This suggests that hospitals can compensate, to some extent, for financial barriers to adoption by cultivating internal IT knowledge stocks, deliberately engaging in knowledge sharing (through system affiliation or information exchange network participation), or absorbing spillover knowledge through geographic proximity to other medical facilities. Consistent with our hypothesis, we found a substitutive effect between cultural capital and institutional-arrangement-based social capital ($\beta = -.05$, p-value = .04), suggesting that knowledge sharing enabled by institutional arrangements (e.g., system affiliation or information exchange network participation) can compensate for a lack of internal IT knowledge stocks. Contrary to our expectation, we did not find a significant substitutive effect between cultural capital and geographic-proximity-based social capital ($\beta = .01$, p-value = .38). Our argument for this substitutive effect is that cultural capital increases an organization's alertness to emerging technologies, making the effect of geographically localized knowledge spillover less critical to the adoption of HITs. A possible explanation for the non-significant interaction effect is that our measure of cultural capital focuses on the internal knowledge held by IT staff but the measure of geographic-proximity-based social capital is inclusive of knowledge of both IT and non-IT (i.e., medical and administrative) personnel. Because of this, cultural capital is only a partial substitute for geographic-proximity-based social capital, substituting only for IT-staff knowledge. Furthermore, the generation of digital options for digitized process and digitized knowledge reach and richness requires an understanding of a hospital's internal processes and systems, which geographic-proximity-based social capital does not typically provide. Finally, consistent with our hypothesis, we found a complementary effect between institutional-arrangement-based social capital and geographic-proximity-based social capital ($\beta = .07$, p-value < .01). Our argument for the complementary effect is that these two forms of social capital provide the hospital with different types of HIT knowledge. While institutional-arrangement-based social capital generates more in-depth knowledge about a specific HIT (e.g., detailed implementation know-how), geographic-proximity-based social capital leads to awareness of new HITs and their benefits and potential implementation pitfalls. Therefore, these two forms of social capital synergistically combine to lower the knowledge barriers to adoption of various HITs.

We also performed a *post hoc* analysis to provide preliminary evidence for the performance impact of digital advantage via the generation of digital options. The results of this analysis show that digital advantage is significantly associated with lower rates of mortality ($\beta = -0.019$, p-value = 0.008) and readmission ($\beta = -0.023$, p-value = 0.009), two important indicators of quality of care. This provides preliminary evidence that digital advantage is consequential to hospital performance, at least as measured by quality of care.

Implications for Research and Practice

Before elaborating our contributions to theory and practice, it is important to discuss the study's limitations. First, because we used archival data, we used proxies to measure the constructs of the study. While our measures of the different types of capital are appropriate and capture the essence of these constructs, survey data may provide more direct and detailed measures of these constructs. Second, our measures of the various forms of capital can be expanded to include additional aspects of the constructs. For example, Bourdieu (1991) suggests three manifestations of cultural capital: embodied (the social actors' knowledge, expertise, and skills), objectified (physical objects, such as pictures, books, dictionaries, instruments, machines, and writings), and institutionalized (institutional recognition, most often in the form of academic credentials or qualifications). Our measure of cultural capital is a proxy for embodied cultural capital because it is the most relevant manifestation of cultural capital to the concept of digital advantage and it is the precondition to objectified and institutionalized cultural capital in that objectified and institutional capital can only be obtained in proportion to the extent of the holder's embodied capital (Everett 2002). Future studies may include all three states of cultural capital. Furthermore, our measure of cultural capital focuses on the internal IT knowledge held by IT staff in hospitals. The internal knowledge held by non-IT staff, such as medical providers and administrative staff, could also be an enabler of hospital HIT adoption, especially for the development and realization of digital options. Future studies may expand our measure of cultural capital by capturing the pertinent knowledge that resides in non-IT staff. Third, the study included a limited array of possible institutional arrangements to measure institutional-arrangement-based social capital. Although arrangements such as multihospital affiliation are dominant knowledge sharing structures in the healthcare industry, future research should explore other types of interorganizational links that may influence the hospital digital advantage. Furthermore, our study only included two types of information exchange networks, so future research could examine additional types of information exchange networks. Fourth, the Saidin index, which we used to measure digital advantage, has the strength of aggregating over a large number of technologies and weighing technologies based on how widely diffused they are among the hospitals; as such, it provides a relative measure of digital advantage. However, it does not differentiate among different types of technologies in terms of scope (i.e., enterprise-wide systems versus narrower scope systems), how they are used in the organization to generate digital options, and how well the stock of technologies in the HIT portfolio integrate with each other to generate or support business and clinical processes and capabilities. Future studies may consider different measures of digital advantage that take into account these nuances. Furthermore, although our conceptual framework elaborates how digital advantage can translate to hospital performance, we only presented preliminary evidence for the performance impacts of digital advantage based on quality of care measures. Our conceptual framework creates a potentially fruitful line of future research; that is, researchers may examine how digital advantage is generative of digital options and consequential to hospital performance. Finally, we posited that knowledge exchange is the mediating mechanism via which institutional-arrangement-based social capital and geographic-proximity-based social capital influence hospital digital advantage. While our measures are consistent with those in the agglomeration literature that examines effects of knowledge spillover on innovation adoption, directly capturing these and other mediating mechanisms represents a meaningful direction for future research.

The study makes several important contributions. First, we develop an integrative conceptual framework of digital advantage by combining Bourdieu's forms of capital with the logic of digital options to explicate how digital advantage can be generated and how, via the creation of digital options, it translates to hospital performance. Using Bourdieu's forms of capital as an organizing framework, we leverage the extant literature on organizational IT adoption and hospital IT adoption to elaborate how the various forms of capital enable the accumulation of HIT stock and the creation of digital advantage in a hospital context. The forms of capital lens enable us to organize, under a cohesive framework, disparate factors posited in the literature. Hence, we contribute to the conversation about factors that enable hospitals to gain a technological edge by suggesting that the various forms of capital are consequential and, therefore, their accumulation is a route to digital advantage, which will further lead to superior hospital performance.

Second, our research framework of forms of capital provides a useful lens to understanding alternative pathways to digital advantage and to the generation of digital options. It is also generative of additional factors for each form of capital. While our focus in identifying the various factors that constitute the forms of capital was the development of a hospital's technological edge, future research may incorporate factors that specifically address the types of cultural, economic, and social capital that are required to generate digital options from digital advantage (i.e., those that are critical to realize the downstream effects of digital advantage). These may overlap but may not be identical to the factors that we identified for digital advantage because the generation of digital options additionally involves strategic foresight and systemic insight (Sambamurthy et al. 2003), which may not be fully captured in our model. In addition, elaborating more fully and testing the pathways via which digital advantage can be leveraged to generate digital options and lead to performance is a fruitful direction for future research.

Third, we examine the substitutive and complementary effects of different forms of capital—an approach that has been largely missing from the studies on organizational IT adoption in general and hospital HIT adoption in particular. Although Bourdieu considers the long-term transformation and conversion between different forms of capital (Bourdieu 1986), his theory is silent about the substitutive and complementary effects of the different forms of capital *at a given point of time*. Thus, we contribute to Bourdieu's framework in the context of digital advantage by examining the substitutive and complementary effects of different forms of capital. Furthermore, we believe that investigating the substitutive and complementary effects between different forms of capital is particularly important for hospitals that do not have sufficient financial resources or internal IT knowledge stocks. The understanding of such substitutive and complementary effects can guide these hospitals to leverage the institutional arrangements or geographic localized knowledge to achieve digital advantage.

Fourth, we differentiate between two forms of social capital: institutional-arrangement-based and geographic-proximity-based social capital. Although intentional interorganizational knowledge sharing (i.e., institutional-arrangement-based social capital) has been intensively examined in the IT adoption literature (e.g., Bharati and Chaudhury 2010, Pennings and Harianto 1992, Ravichandran 2005), unintentional knowledge spillover due to geographic proximity has received less attention. Bourdieu's conceptualization of social capital allows us to integrate different mechanisms of knowledge flow into the same framework. Our results reveal the important role played by geographic-proximity-based social capital in fostering digital advantage, which spurs future studies to examine the effects of geographic-proximity-based social capital in more depth. For example, although we examined the role of horizontal spillovers (from other medical facilities), vertical spillovers (e.g., from firms across the supply chain, different industries, consultants, etc.) may also play an important role. Theorizing how other types of geographic-proximity-based social capital may influence digital advantage is a worthy future direction. Further, although geographic-proximity-based social capital has an effect on digital advantage, a pertinent question is whether the importance of knowledge spillover through geographic-proximity-based social capital will decline as virtual communication technologies allow organizations to communicate, collaborate, and exchange tacit and explicit knowledge across space. Then, an interesting question for hospitals located in areas with a low concentration of other medical facilities is how to create digital knowledge spillovers rather than geographic knowledge spillovers. Additionally, our differentiation between the two forms of capital also calls for a better understanding of institutional-arrangement-based social capital. Using social network analysis, future research can examine how various types of organizational network configurations may facilitate or inhibit knowledge flows and how the network structure of such network configurations influences knowledge sharing among participants.

Fifth, leveraging Bourdieu's forms of capital and the literature on organizational IT adoption, we identify a set of systemic factors that not only predict digital advantage but also generalize across the adoption of any IT. Given that these factors are not idiosyncratic to a specific IT, they provide a general framework and starting point for organizational IT adoption studies irrespective of the specific IT being studied. Thus, our results extend the organizational IT adoption literature by identifying a set of factors that are not idiosyncratic to adoption of any specific IT. Furthermore, Bourdieu's theory allows us to integrate many of these disparate factors from prior literature (see Appendix A) into a unified and cohesive framework. This can spearhead future research related to organizational IT adoption in a systematic and programmatic manner.

Sixth, the concept of digital advantage takes into account the number and rarity of an organization's bundle of adopted ITs relative to its competitors. We operationalized this construct using the Saidin index, which takes into account the extent of diffusion of a technology to discount widely diffused technologies, such as payroll, and to give more weight to adoption of newer, less diffused technologies, such as RFID patient tracking and telehealth, given that they are more likely to generate digital options. Thus, our measure of digital advantage more accurately reflects an organization's technological edge to generate digital options at a given point of time than a simple count of technologies adopted by the organization. Although our literature review shows that a few existing studies have used the index to measure adoption of HITs, they only focus on a limited number of clinical information technologies. As previously discussed, the technologies supporting hospital administrative activities have distinct positive effects on hospital performance in the long run, and the clinical activities are dependent not only on other clinical activities but also on many administrative activities (Menon et al. 2009). Because of the interdependence of these activities, a broad array of HITs supporting both clinical and administrative processes will likely generate more digital options by strengthening the reach and richness of digitally enabled processes. Therefore, it is important to measure digital advantage based on a composite of HITs spanning clinical and administrative processes. Our Saidin index-based measure of digital advantage can be leveraged by other studies that seek to examine the effect of an organization's technological edge on organizational competitive outcomes.

Finally, although we developed our conceptual framework in the hospital context, our approach can be leveraged by future research examining digital advantage for other types of organizations and industries, which can develop their own context-specific measures of capital. Our operationalization of economic and cultural capital is directly applicable to organizations in other industries. The institutional-arrangement-based social capital in our research takes into account institutional arrangements specific to healthcare, including multihospital systems and information exchange networks. Nonetheless, similar institutional arrangements can be found in other industries. For example, organizations in other industries may obtain institutional-arrangement-based social capital from their parent organizations, alliances, or professional and trade associations. Similarly, the geographic-proximity-based social capital can be identified for organizations in other industries based on their proximity to other organizations in the same industry, organizations known for strong IT capabilities, and leading IT providers. Although the two forms of social capital will be conceptualized and operationalized differently in other industries, the different forms of capital driving digital advantage (and their interactions) can generalize to other organizations. Further, given that the various forms of capital are unevenly distributed across organizations, our theorizing opens up avenues on theorizing how organizations in general can accumulate capital for digital advantage to improve their competitive position.

Our study also has important practical implications. First, the Saidin index used in our study can provide a standardized measure for organizations to gauge their digital advantage or ability to generate digital options. Second, organizations can take strategic actions based on their capital configurations to improve their digital advantage. For example, research shows that financial constraints pose significant challenges for many small, rural hospitals during the initial phases of HIT implementations (Altarum Institute 2011; DesRoches et al. 2012). Our results show that institutional-arrangement-based social capital has the strongest effect on digital advantage and that social capital is especially important for hospitals with limited economic and cultural capital. Therefore, to improve digital advantage, small rural hospitals can seek institutional arrangements to mitigate the constraining effects of their financial challenges. For example, they can actively engage in social networks by becoming part of an alliance and by being active members of information exchange networks and initiatives. Furthermore, although organizations can do little to change their geographic location to benefit from geographic-proximity-based social capital, new organizations can capitalize on strategic location choices in order to maximize their knowledge spillover effect from geographic-proximity-based social capital (Alcácer and Chung 2007). In addition, since geographic-proximity-based social capital is based on informal interactions and informal knowledge exchanges, similar effects may be achieved by encouraging strong interpersonal networking across organizations (Singh 2005) or through professional and trade associations.

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