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Enterprise architecture, IT effectiveness and the mediating role of IT alignment in US hospitals

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Abstract. *Despite the possible benefits of implementing healthcare information technologies, successful implementation of effective healthcare information technology is constrained by cultural and regulatory concerns and technical obstacles encountered when establishing or upgrading an organisation's enterprise infrastructure. In this paper, we advance Ross' four-stage model of enterprise architecture maturity as a valuable IT resource for helping healthcare organisations sustain a competitive advantage. We use partial least squares (PLS) structural equation modelling to analyse survey data from 164 US hospitals at different stages of EA maturity. Our results provide evidence that enterprise architecture maturity directly influences the effectiveness of hospitals' IT resources for achieving strategic goals. Further, enterprise architecture maturity indirectly influences the effectiveness of IT resources when IT alignment is incorporated as a mediating variable. We discuss the implications of our findings for research and practice and suggest opportunities for future research.*

Keywords: Enterprise architecture, IT alignment, IT effectiveness, health care, mediation, survey

INTRODUCTION

The healthcare industry continues to experience major transformations in its application of information technology (IT) (Al-Nashmi, 2003; Wilson & Lankton, 2004). Health care is the

largest single industry worldwide (Wilson, 2004), and the transformations experienced by organisations in the healthcare industry are expected to be widespread. This expectation is partly due to US and international regulations, such as the US Health Insurance Portability and Accountability Act of 1996 (HIPAA), Canadian Health Information Protection Act of 2004 and European Union Data Protection Directive of 1995.

The mandates brought about by these types of laws and regulations can place significant burdens on healthcare organisations' IT units. The burdens are primarily in the areas of data and systems standardisation and integration, security controls to protect personal data and data portability. In addition to US and international laws and regulations, two major forces have created unprecedented demands on IT executives and hospital administrators to design, implement and manage new healthcare information systems and carry out large-scale IT integration projects (Wilson & Lankton, 2004). These forces include:

- Financial motivations and various types of inter-organisational relationships (e.g. mergers, acquisitions, consolidations, partnerships).
- Pressure from patients who want healthcare providers to meet patients' needs by supporting technology that would enable healthcare providers to supply more resources electronically, including healthcare information, medical consultation and instrumentation for diagnosis, monitoring and treatment of medical conditions.

Given the need for US healthcare organisations to be able to achieve and sustain competitive advantage in such a dynamic and uncertain environment, many healthcare providers have created initiatives to integrate formerly disparate technologies (Goedert, 2005). In doing so, healthcare providers are recognising that a collection of healthcare information technologies (HIT), rather than an individual tool, is what contributes to superior performance (Goedert, 2005). Therefore, a primary goal of such initiatives is to identify appropriate IT resources that can facilitate superior performance. IT resources are assets and capabilities that are available and useful in detecting and responding to market opportunities or threats (Wade & Hulland, 2004). Integration and standardisation efforts, related to the collection of IT resources, are vital to the accomplishment of such initiatives and can be facilitated via enterprise architecture (EA).

Broadly defined, EA is the organising logic for an organisation's IT infrastructure and business processes. 'Organizations design EA to address the problems caused by legacy systems. Its intent is to identify the key technology, data and system components that must be shared across multiple parts of the organization. Once designed, most organizations then gradually build out their EA by isolating (and usually standardizing) the components that will be used by multiple stakeholders' (Ross & Beath, 2006, p. 182). In the context of this study, EA is defined as a plan (or set of plans) that guides healthcare management responsibilities and strategies, including the identification and use of IT resources (Allen & Boynton, 1991; Curle, 1993; Hildebrand, 2000; Ross, 2003). Once identified, appropriate leveraging of these IT resources has the potential to provide hospitals with competencies that are congruent with their competitive needs rather than existing patterns of usage within the organisation (Richardson & Jackson, 1990; Segars & Grover, 1998). Thus, the corresponding value derived from IT can enable organisations to gain and sustain competitive advantage (Earl, 1989; Keen,

1991; Gibson, 1994; Periasamy & Feeny, 1997; Hagel & Brown, 2001; Sauer & Willocks, 2002; Ross, 2003; Ross & Westerman, 2004; Bradley & Byrd, 2007).

The design, implementation and use of EA occurs as a four-stage process through which an organisation moves from an initial IT architecture of individual applications to an increasingly mature, enterprise level architecture complete with standards, technologies, and linkages to strategic opportunities and organisational objectives (Ross, 2003; Ross *et al*., 2006). To date, the prevailing research in the area of EA is mostly qualitative in nature and continues to be instrumental in the development of theory pertaining to the strategic value of an EA. Yet, published studies that empirically test the relationship between an organisation's stage of EA maturity and the effectiveness of an organisation's IT resources for sustaining competitive advantage are lacking. With this study, we hope to fill this important gap in the IT literature. Specifically, we address the following research questions:

Research Question 1: To what degree does a hospital's stage of enterprise architecture maturity influence the organisational impact of its IT resources?

Research Question 2: What is the nature of the relationship (e.g. direct or indirect) between a hospital's stage of EA maturity and the organisational impact of its IT resources?

We intend to answer the above questions by empirically testing the direct effect of the stage of EA maturity on the operational impact of IT resources, which we refer to as operational IT effectiveness (i.e. IT's contribution to the improvement of hospital operations) within US healthcare organisations. Furthermore, previous research (Bradley & Byrd, 2009; Bradley *et al*., 2011) has indicated that moving to higher levels of EA maturity results in increased IT alignment – the alignment between hospital's business and IT plans, priorities and strategies. In conjunction with previous research that has shown a relationship between IT alignment and the strategic impact of IT (cf. Kearns & Sabherwal, 2007), this points to a possible indirect pathway by which the stage of EA maturity influences IT's strategic impact on hospitals, which we refer to as enterprise agility (i.e. hospitals' ability, as enabled by IT, to sense environmental change and respond readily) in this study. We propose to examine this indirect effect by empirically assessing the mediating role of IT alignment. The remainder of this paper proceeds as follows: First, we define and describe IT resources. Second, we explain the proposed constructs of EA maturity, IT alignment, IT effectiveness and enterprise agility, and then we present our research hypotheses. Next we describe the research methodology and the field study used to test the proposed hypotheses, and then we present the data analysis and results. Finally, we discuss the contributions of this study and implications for theory and practice.

THEORETICAL DEVELOPMENT

The elements of our research model consist of EA architecture maturity, IT alignment, operational IT effectiveness and enterprise agility. Figure 1 provides a conceptualisation of the expected relationships among the elements of our research model. In this section, we examine each of these elements in more detail.

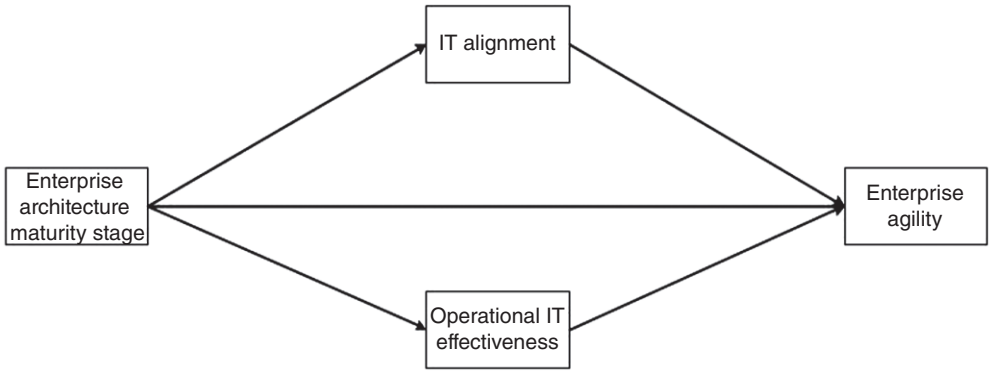

Figure 1. Conceptual model.

Enterprise architecture maturity

Organisational architectures have received attention in the IT literature for more than two decades. A review of the literature indicates a paradigm shift from functional- and business unit-level architectures to enterprise-level architectures. Within this paradigm shift, there is an increase in complexity, intensity and detail as it relates to organisational architectures and ultimately leads to the EA model.

Whereas architectures that preceded the EA focused more on systems development, data sharing and systems integration efforts within the organisation, the EA focuses more on the governance of IT resources within the organisation in addition to the aforementioned elements. EA provides organisations with the knowledge to utilise and leverage those IT resources in a manner that would enable the organisation to gain and sustain competitive advantage and quickly adapt to changes in technology, their respective organisation, their respective industry, and their inter-organisational relationships and alliances (Allen & Boynton, 1991; Ross, 2003). Organisations that do not evolve their EA over time may find it difficult to adapt quickly and appropriately to changes that can occur as a result of shifts in the marketplace or strategic restructurings.

Just as multiple architectural representations and foundations exist, there are variations in the representation of an EA. For the purposes of this study, we adopt a learning-in-stages approach to discuss EA (Ross, 2003). With this approach, there are four stages of architectural maturity – the business silo stage, the standardised technology stage, the optimised core stage and the business modularity stage. Organisations in the business silo stage focus their resources on developing individual applications. Organisations in the standardised technology stage focus their efforts and resources on the development of a shared infrastructure. Organisations in the optimised core stage focus their efforts and resources on data management and infrastructure development. Organisations in the business modularity stage focus efforts and resources on attaining strategic agility.

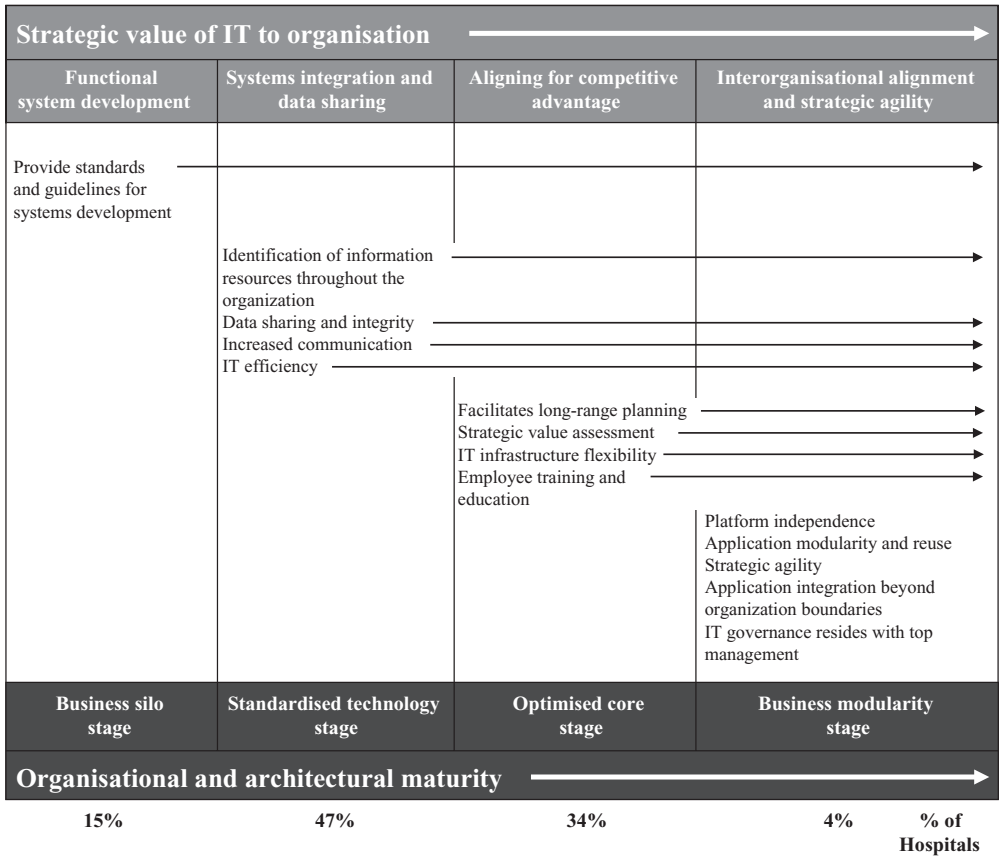

Figure 2. Stages of EA maturity.

Organisations that develop and implement architectures representative of the various stages possess certain organisational and EA competencies; these competencies are needed to develop synergy between business strategy and EA (Ross, 2003). Additionally, organisations that develop competencies in a lower stage of the EA before moving on to the next stage typically obtain better and more measurable strategic benefits (Ross, 2003). Figure 2 depicts the strategic implications of IT and the associated capabilities organisations have realised relative to their stage of EA maturity. An interesting thing to note about Figure 2 is the similarity between the healthcare sector and other industries with respect to the percentage of organisations in each stage of EA maturity. The percentage of organisations in other industries along each stage of EA maturity is as Ross' (2003) reports and is relative to the number of organisations that participated in her study. The percentage of healthcare organisations along each stage of EA maturity is based on the classification of the hospital participants in this study.

IT alignment

Competitive advantage and sustained competitive advantage continues to be sources of concern for many organisations. IT alignment is one means by which competitive advantage can be attained and sustained (Kearns & Lederer, 2000; Reich & Benbasat, 2000). IT alignment is the degree to which the IT strategies, objectives and priorities support business strategies, objectives and priorities (Kearns & Lederer, 2000; Reich & Benbasat, 2000; Chan, 2002; Kearns & Sabherwal, 2007).

Whereas IT alignment was once considered a luxury for most organisations, it is now considered a necessity for those organisations that wish to keep pace and remain competitive in today's fast changing environment (Johnston & Carrico, 1988; Johnston & Vitale, 1988; Sabherwal & Chan, 2001). It has been suggested that the perceived importance of the IT resources is heightened by such alignment, thus facilitating the financial and managerial support necessary to effectively implement innovative systems (Richardson & Jackson, 1990; Segars & Grover, 1998). In addition to this, once strategic alignment has been achieved, organisations are better positioned to embed core business processes in their IT infrastructure (Gibson, 1994; Butler, 2001; Ross, 2003).

The organisational impact of IT

The organisational impact of IT has been measured in a number of ways. For this study, we adopt the IS success model (DeLone & McLean, 1992). The measurement of IS success or the impact of IT has been widely studied (DeLone & McLean, 2003; Bradley *et al*., 2006; Wang, 2008), and it provides an opportunity to examine intermediate impacts of IT (Barua *et al*., 1995; Rai *et al*., 1996; 1997; Brandyberry *et al*., 1999), which is consistent with the objectives of this study. One difficulty in studies of IS success (DeLone & McLean, 2003) cited by Seddon (1997) is the multi-faceted meaning of IT use (e.g. benefits from use, future IT use, impact of use). For this study, we have chosen the impact of use, which we refer to as IT effectiveness. With this designation, it is not the use of IT itself that is the measure of its effectiveness but the impact or success of that use on or within the organisation that is important (Seddon, 1997; Bradley *et al*., 2006). Prior studies have considered the effectiveness of IT at both strategic (Rai & Bajwa, 1997; Bradley *et al*., 2006) and operational levels (Banker *et al*., 1990; Bradley, 2006; Bradley *et al*., 2006). As such, we consider the operational impact of IT, classified as operational IT effectiveness and the strategic impact of IT, referred to as enterprise agility.

Operational IT effectiveness

Operational IT effectiveness focuses on the improvement of business operations (Avison *et al*., 2004). Viewing IT effectiveness in this manner provides greater insight about the IT-enabled performance of the organisation by considering the value or effectiveness of IT through a web of intermediate level contributions (Barua *et al*., 1995) instead of at an aggregate level as in Brynjolfsson & Hitt (1996).

Enterprise agility

Enterprise agility is defined as an organisation's ability, as enabled by IT, to sense environmental change and respond readily (Sambamurthy *et al*., 2003; Overby *et al*., 2006). Environmental change pertains to changes precipitated by competitors' actions, consumer preference changes, regulatory or legal changes and technological advancements. We capture these elements of environmental change, which are fundamental to enterprise agility, via organisations' management of external relationships and their response to market opportunities.

HYPOTHESIS DEVELOPMENT

EA maturity and IT alignment

The IT literature contains various surveys and reports that list the issue of strategic alignment between IT and organisational objectives as a major concern of IT managers and business executives (Niederman *et al*., 1991; Galliers *et al*., 1994; Brancheau *et al*., 1996; Reich & Benbasat, 2000). IT alignment includes a superset of multiple, simultaneous component alignments that bring together an organisation's structure, strategy and culture at multiple (IT, business unit and corporate) levels with all their inherent demands (Chan, 2002). For IT alignment to occur, managers must intertwine technology and business processes (Keen, 1991). IT and business managers must work together to develop a synergy between four factors that together meet corporate strategic objectives: business strategy, IT strategy, business infrastructure and IT infrastructure (Baets, 1992; Henderson & Venkatraman, 1993). Armour *et al*. (1999) argue that EA provides a general blueprint for creating enterprise-wide information systems. Ross *et al*. (2006) intimate as organisations' EA mature, IT and business processes are more aligned resulting in enterprise-wide systems that can help support organisations' strategy execution in a coordinated manner. Bradley & Byrd (2009) demonstrate that the level of alignment between business and IT increases as an organisation's EA matures. Part of the reason EA is expected to have a positive impact on IT alignment is attributed to EA's role in contributing to an improved understanding of the enterprise (Dragstra, 2005).

The main objective of EA is to align data, applications and technology with business processes to support business operations, goals and strategy (Ross *et al*., 2006). Hence, as an organisation's EA matures, it is expected to lead to greater IT alignment because it facilitates the realisation of business objectives by aiding decisions on and the identification of IT resources that can potentially support business objectives, strategies and priorities (Dragstra, 2005; Ross *et al*., 2006; Bradley & Byrd, 2009). In light of these arguments, we posit that achieving IT alignment through the use of EA is accomplished in incremental steps as an organisation moves through the stages of EA maturity. Therefore, we hypothesise the following:

H1: An increase in the stage of EA maturity will lead to increased IT alignment.

EA and enterprise agility

EA serves as a major catalyst in the prioritisation, selection and management of IT projects, and prior studies have found that the maturity of an EA influences IT's strategic impact (Ross *et al*., 2006; Bradley *et al*., 2011). Organisations that have experienced successful results from their IT investments are three times more likely to have and use formal plans for systems development (Doll, 1985; Sabherwal, 1999). Correspondingly, IT planning success often predicts improvement in systems' capabilities (Raghunathan & Raghunathan, 1994). Characteristic of the IT plans employed by successful organisations, an EA provides a framework of standards for new systems that can facilitate better management of systems development projects and improved productivity in systems development and maintenance (Goodhue *et al*., 1988; 1992).

As organisations mature their EA, they are better able to use business cases to justify their IT investments (Ross *et al*., 2006; Bradley *et al*., 2011). Most business cases for IT investments are strategic in nature, such as the need to improve the return on investment of existing and new applications or the desire for improved speed to market of products and services (Ross *et al*., 2006). In this sense, EA captures the essentials of business and IT, while allowing for flexibility and adaptability (Jonkers *et al*., 2006). As such, we would expect organisations to be more agile as their EA matures. This expectation is based on the guidance EA provides in optimising IT investments to digitise core business processes (Ross *et al*., 2006). For instance, Ross *et al*. (2006) and Weill & Ross (2009) found that organisations with a higher percentage of digitised core processes were more agile. Given that digitisation of core processes is inevitable as organisations mature their EA, unless they choose not to digitise them (even then such organisations still possess the competence to digitise their core processes), we would expect the stage of EA maturity to influence enterprise agility. Based on these findings and the arguments presented above, we posit the following:

H2: An increase in the stage of EA maturity will lead to an increase in enterprise agility.

EA and operational IT effectiveness

EA describes how processes, data, applications and technologies interrelate, and the methods and processes to help develop or acquire systems in a coordinated fashion (Espinosa *et al*., 2011). EA also attempts to address challenges associated with these tasks by describing the common information used by an organisation and the relationships among collections of data at an enterprise level (Bradley & Byrd, 2009). As such, EA documents the interrelationships of data availability and information needs across organisational and application boundaries (Ross *et al*., 2006; Espinosa *et al*., 2011).

Lagerström *et al*. (2011) report that EA provides for a more efficient IT operation. Further, they find that as organisations work to mature their EA, the effectiveness of IT within the organisation increases. Bradley & Byrd (2009) argue that as the EA matures, it arms organisations with the requisite knowledge to resolve issues and problems associated with application segregation and disjointedness by identifying the data needs and IT resources throughout

the organisation. Grimson *et al*. (2000) and Espinosa *et al*. (2011) purport that a more mature EA enables organisations to overcome their inability to share data, thus minimising data redundancy and associated errors. From there, organisations are better positioned to shift their focus to data sharing and systems integration. By doing so, organisations are poised to leverage IT to have more effective business operations by standardising business processes and sharing data across departmental units (Grimson *et al*., 2000; Ross *et al*., 2006). Such data transparency and process standardisation, which evolves as organisations mature their EA, has been shown to reduce operational errors (Kumar & Aldrich, 2010). Based on these findings and arguments, we posit the following:

H3: An increase in the stage of EA maturity will lead to an increase in operational IT effectiveness.

IT alignment and enterprise agility

IT alignment has been found to be a facilitator of agility (Monteiro & Macdonald, 1996; Sabherwal & Chan, 2001; Chan, 2002; Sauer & Willocks, 2002; Kumar, 2004; Kearns & Sabherwal, 2007; Tallon & Pinsonneault, 2011). The effective and efficient utilisation of IT requires the alignment of the IT and business strategies, processes and priorities (Luftman *et al*., 1993; Kearns & Sabherwal, 2007). As such, Sabherwal & Chan (2001) and Chang (2006) report on IT alignment's positive impact on organisational performance.

Prior studies (Overby *et al*., 2006; Kearns & Sabherwal, 2007; Tallon & Pinsonneault, 2011) suggest the likelihood of agility is much higher when there is mutual understanding of and commitment to IT and business goals, incentives and approaches. Moreover, Mathiassen & Pries-Heje (2006) echo this sentiment and argue that aligning the IT strategy with the business strategy will likely have an impact on organisations' agility. In addition, Mathiassen & Pries-Heje (2006) put forward that agility comes into play when crafting the business strategy and aligning it with the IT strategy. In essence, they imply that IT alignment must evolve in such a way as to allow enterprise agility to unfold. Hence, we posit the following:

H4a: An increase in IT alignment leads to an increase in enterprise agility.

Indirect impact of EA maturity on enterprise agility via IT alignment

We have argued the direct impact of EA maturity on enterprise agility. Likewise, we have argued the impact of IT alignment on enterprise agility. Furthermore, we believe the impact of IT alignment on enterprise agility could outweigh the impact of EA maturity on the same variable. Based on knowledge considerations, IT managers' participation in business planning and business managers' participation in IT planning has been shown to mediate the effects of centralisation of IT decisions (Kearns & Sabherwal, 2007). Although Kearns & Sabherwal (2007) investigated the effects of centralisation of IT decisions on IT alignment's impact on business effects of IT, it is plausible that the mediating effect can be argued the other way. Centralisation of IT decision-making is an artefact of a mature EA; decisions become increasingly centralised as an organisation moves to a higher level of EA maturity (Ross *et al*., 2006).

As the EA matures, one of the end results is better IT alignment (Dragstra, 2005; Bradley & Byrd, 2009). This argument suggests an indirect impact of EA maturity on enterprise agility. Thus, IT alignment's effect on enterprise agility could potentially mediate the effects of both the centralisation of IT decisions and shared domain knowledge (both of which are elements of focus for a mature EA) on enterprise agility. Therefore, we posit the following:

H4b: IT alignment mediates the effect of the stage of EA maturity on enterprise agility.

Operational IT effectiveness and enterprise agility

Operational IT effectiveness and enterprise agility are key IT resources in determining the success of IT use. Research has explored each as dependent variables (see Wade & Hulland, 2004 for an extensive list of relevant articles), but few researchers have explored the influence of operational IT effectiveness on enterprise agility despite some conjecture of a possible relationship (Clemons & Row, 1991; Wade & Hulland, 2004). For example, Wade & Hulland (2004) suggest that direct and indirect relationships may exist among the aforementioned resources, which could further extend the impact of IT use in hospitals. Because enterprise agility applies to both strategic and operational issues, it is possible to have both operational IT effectiveness and enterprise agility simultaneously.

Because the crux of hospitals' performance is based on the efficiency and effectiveness of their operations, enterprise agility is likely to be dependent on operational IT effectiveness. One potential justification for the direction of this relationship is that a hospital that is prone to operational errors is likely to have difficulty in successfully marketing new services or initiatives. Further, misinformation, which is usually at the centre of operational errors (Institute of Medicine, 2000), can have a profound impact on hospitals' ability to effectively communicate with stakeholders and respond to their needs in a timely manner. Additionally, as some argue that agility is the successful exploration of competitive bases (Yusef *et al*., 1999; Swafford *et al*., 2006; Swafford *et al*., 2008), it is plausible that operational IT effectiveness will influence enterprise agility. This relationship is likely because operational IT effectiveness, especially from the perspective of reducing operational errors, is likely to influence the dimensions upon which organisations (including hospitals) would compete (e.g. speed, flexibility, innovation, proactivity, quality, profitability) (Yusef *et al*., 1999; Swafford *et al*., 2006; 2008). Furthermore, IT integration, which is vital to operational IT effectiveness (Byrd & Turner, 2000), enables an organisation to better identify its available options for making decisions related to utilising its agility (Swafford *et al*., 2008).

Applying the generally accepted paradigm in the strategy literature that capabilities are externally focused while competencies are internally focused and considered antecedents of capabilities (Teece *et al*., 1997; Zhang *et al*., 2002; Swafford *et al*., 2006). Further, scholars suggest that capabilities are derived from competencies (Prahalad & Hamel, 1990; Roth & Jackson, 1995; Teece *et al*., 1997). Consistent with this strategy paradigm, we view enterprise agility as an externally focused capability that is derived from IT-enabled error detection and reduction (i.e. operational IT effectiveness), which is in turn viewed as an internally focused

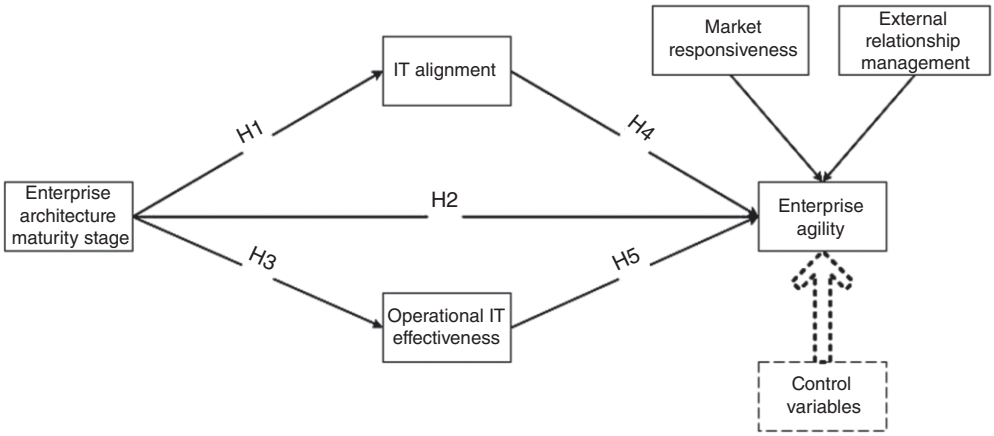

Figure 3. Research model.

competency. Based on this statement and the logical arguments presented above, we posit that operational IT effectiveness is an antecedent of enterprise agility. Therefore, hypothesis 5 is as follows:

H5: An increase in operational IT effectiveness leads to an increase in enterprise agility.

Figure 3 depicts the abovementioned hypotheses in the context of our research model. In the subsequent sections, we operationalise our constructs and assess the validity and reliability of our measures. This is followed by our data analysis and the result of the testing of our hypotheses illustrated in Figure 3.

RESEARCH METHOD

Measurement development

Wherever possible, we adapted measurement items from existing scales. We measured all survey items, with the exception of EA maturity stage (discussed in the next subsection) on a Likert-type scale anchored by 'not at all' (1) and 'very great extent' (7) or 'strongly disagree' (1) and 'strongly agree' (7). Prior to administering the survey, 14 Chief Information Officers (CIOs) and three academicians knowledgeable about EA and IT strategic planning in healthcare organisations reviewed the survey for understandability of the questions being asked, clarity of the questions and consistency of the terminology used in the questions with that used in the healthcare industry. Table 1 shows the measurement items used in the current study.

EA maturity stage

We measured EA maturity stage with a single item in which respondents were to review the description of each stage (without stage numbers or names) and choose the description that

Table 1. Measurement items

Construct	Measures	Source
EA maturity stage	Review the description of each stage and choose the description that most closely depicts your organisation's IT capabilities	Ross (2003) and Ross *et al*. (2006).
IT alignment	• My organisation has a business plan to use existing technology to enter new market segments • My organisation has a business plan to develop new technologies for new kinds of products/services • Business and IT strategies are consistent	Chan (2002)
Operational IT effectiveness	*Based on the past five (5) years, please rate the extent to which IT has improved each of the following.* • My organisation's ability to detect/catch clinical errors. • My organisation's ability to reduce clinical errors	Hamilton & Chervancy (a,b).
Enterprise agility – market responsiveness	*Based on the past five (5) years, please rate the extent to which IT has improved each of the following.* • My organisation's speed of response to stakeholders' needs • My organisation's ability to tailor products/services to individual stakeholder needs • The speed at which my organisation can enter new markets • My organisation's ability to quickly respond to changes in regulations • The rate at which my organisation can introduce new products/services	Bharadwaj (2000) and Weill (1992)
Enterprise agility – external relationship management	*Based on the past five (5) years, please rate the extent to which IT has improved each of the following.* • My organisation's ability to work with external suppliers to leverage shared IT capabilities to create high-value IT resources • My organisation's ability to manage relationships with outsourcing partners • My organisation's ability to manage relationships with contracted caregivers who are not employed by this organisation	Bharadwaj (2000) and Feeny & Willcocks (1998)

most closely depicts their organisation's IT capabilities. The single item, self-classification approach has been used in prior organisational studies (Miles & Snow, 1978; Snow & Hrebiniak, 1980; McDaniel & Kolari, 1987; Segev, 1987; Zahra, 1987). The descriptions for each stage are taken from Ross (2003) and Ross *et al*. (2006).

IT alignment

We measured IT alignment using three items adapted from Chan (2002) to capture organisations' IT strategic alignment between hospital's business and IT plans, priorities and strategies.

Operational IT effectiveness

We measured operational IT effectiveness using items developed by Hamilton & Chervancy (1981a,b). We chose two items to capture the effect IT had on a hospital's ability to catch and prevent. To ensure that we captured what we intended, and that the respondents understood the scope of assessing the effect of IT, we prefaced the items with the following statement: 'Based on the past five (5) years, please rate the extent to which IT has improved each of the following'. We chose to have the respondents consider a five-year window to assess the effectiveness of IT because it covered the latter five years of the 10-year existence of HIPAA. This scope was important because the enactment of HIPAA served as a major impetus for much of health care's investment in IT for clinical purposes (Al-Nashmi, 2003; Wilson & Lankton, 2004).

Enterprise agility

We operationalised enterprise agility as a second order formative construct consisting of market responsiveness and external relationship management. We proffer these two variables as formative first-order constructs, because they focus on elements of environmental change (i.e. changes precipitated by competitors' actions, consumer preference changes, regulatory or legal changes and technological advancements) fundamental to enterprise agility. Given that agile organisations must be able to sense how this change affects their operations and implement any needed safety improvements in a timely manner (Overby *et al*., 2006), market responsiveness and external relationship management are important to the measure of enterprise agility. Their importance is highlighted even further considering that organisations need to be agile to handle strategic issues such as those created by competitor moves or changing customer preferences (Overby *et al*., 2006).

To ensure that we captured what we intended, and that the respondents understood the scope of assessing the effect of IT, we prefaced the items for market responsiveness and external relationship management with the same statement (and for the same reasons) discussed in the aforementioned section on operational IT effectiveness. We measured market responsiveness using five items developed by Bharadwaj (2000) and Weill (1992) to capture the effect IT had on a hospital's ability to respond to market opportunities and conditions and stakeholders' (e.g. any combination of patients, physicians, insurance carriers, regulatory agencies, suppliers) needs.

We measured external relationship management using three items developed by Bharadwaj (2000) and Feeny & Willcocks (1998) to capture the effect IT had on a hospital's ability to manage relationships with outsourcing partners, vendors and contracted caregivers (e.g. physicians, nurses and other clinicians not directly employed by the hospital).

Control variables

The control variables used in this study were number of non-IT full time equivalents (FTE), number of IT FTE, number of staffed beds and hospital profit status. We chose non-IT FTE and

number of staffed beds as proxies for hospital size. We chose IT FTE as a proxy for IT unit size. We chose hospital profit status to account for differences in profit motives among hospitals. In addition, we controlled for hospitals in the same partnership. These variables have been consistently used in prior studies related to IT strategic planning and implementation and healthcare informatics (Byrd & Davidson, 2003; Liang et al., 2004; Bradley et al., 2006).

Data collection

Sampling

The population of interest for this study is US hospitals, as identified in the 2006 Health Information and Management Systems Society (HIMSS) Analytics Database (HIMSS Analytics, 2008), formerly known as the Dorenfest Integrated Healthcare Delivery Systems (IHDS+) Database, which contains information on more than 5000 hospitals and 28 000 medical facilities in the US The database contains various types of data about these healthcare organisations such as their IT applications, the existence of IT plans and policies and IT department costs and composition. We determined this population by identifying both independent hospitals and hospitals that are part of a conglomerate (e.g. integrated delivery system or network, multi-hospital system) that have a CIO or IT Director at the hospital level. We reduced the target population by eliminating hospitals that had the same CIO. For example, if four hospitals in the target population had the same CIO listed, even if the CIO was at the hospital level, we eliminated all four hospitals from the population. We took this approach of reducing the population to minimise the risk of the CIO reporting the same data for multiple hospitals, thus affecting the variance of the data reported, and to reduce the chance that the CIO would inadvertently report the wrong information for a hospital.

After identifying the study's population, we used the hospitals' profit status to divide the data into two strata: for-profit and not-for-profit. We then generated random numbers for the hospitals in each stratum and sorted the data in ascending order. While maintaining consistency between the sample and population, relative to the ratio of not-for-profit to for-profit hospitals, we chose 1000 hospitals from the population as the targeted sample for the current study.

Survey administration

We obtained contact information for individuals identified as CIOs from the HIMSS Analytics Database. We sent requests for participation in the study and instructions for completing the survey via email to CIOs of the hospitals in the targeted sample pool. The email included an explanation of the study, its purpose, its anticipated contribution and a link to the sponsor letter from the CEO of HIMSS Analytics, the research arm of HIMSS. We included the link to the electronic survey in the email so that interested participants could complete the survey at the time and location of their choosing. We offered a complimentary report of the summarised

results of the study to all participants as an incentive to participate in the study (nearly 95% of the respondents requested this report).

Of the 1000 CIOs in the sample, 45 could not be contacted, and 81 indicated that their hospital or healthcare system policy forbade their participation in the study (although these executives were from different hospitals, their hospitals were part of the same healthcare system). After two reminders, we received 167 responses (19%). We eliminated three responses from the data set after we deemed them as not useable due to incomplete data. The responding hospitals, on average, have 822 non-IT FTE, 35 IT FTE, 151 staffed beds and net operating revenues of $122 million. We tested for non-response bias by verifying that early and late respondents did not significantly differ in their demographic characteristics and responses on principal constructs. We identified early respondents by selecting those that responded in the first two weeks. All *t*-tests between the means of the two groups showed no significant differences ($p < 0.05$ level). The breakdown of not-for-profit (NFP) and for-profit (FP) hospitals that responded was 85% and 15%, respectively. The ratio of NFP to FP for responding hospitals in this study is comparable to the general population, which is 82% NFP and 18% FP. The relative comparability of this ratio between the sample and the population makes it more likely that the results derived from the current study are generaliseable to the population.

DATA ANALYSIS AND RESULTS

Analysis

We employed partial least squares (PLS) structural equation modelling to test the hypothesised relationships in this study. Petter *et al*. (2007) recommend that the relationship between the measures and construct be closely examined, even when using measures previously validated and used in other research studies. Although our measures were derived from prior studies, in which they were modelled as reflective indicators, we examined our measures to determine the appropriate way to model the constructs. We applied four established decision rules (see Jarvis *et al*., 2003; Petter *et al*., 2007; Roberts & Thatcher, 2009) in deciding whether to conceptualise each of our multi-item constructs as reflective or formative. The four decision rules pertained to (1) the theoretical causal direction between the construct and indicators; (2) indicator interchangeability; (3) whether indicators covary; and (4) whether indicators have the same antecedents and consequences. Following these decision rules, we modelled IT alignment and market responsiveness as formative, and we modelled operational IT effectiveness and external relationship management as reflective. We approximated the second-order construct, enterprise agility, with the measurement items of the first-order factors (i.e. market responsiveness and external relationship management) also known as the repeated indicators approach (Chin *et al*., 2003). Using the abovementioned four decision rules as a guide for our second-order construct, it seemed appropriate to model enterprise agility as formative.

Measurement validation

In accordance with prior studies (Henseler *et al*., 2009), we assessed the validity and reliability of the items and constructs in our model. We assessed the validity and reliability of the reflective items and constructs by examining the loadings of items on their respective latent variable (Hulland, 1999). The higher loadings imply that there is more shared variance between the construct and its associated items than error variance (Hulland, 1999). As represented in Table 2, all items loaded heavily and significantly (at $p < 0.05$) on their respective constructs; the results are indicative of individual item reliability.

Consistent with prior studies (Bradley *et al*., 2006; Karim, 2009; Hult *et al*., 2010), we assessed the reliability of our scales using composite reliability (ρ) (Werts *et al*., 1974). Composite reliability is preferred over Cronbach's alpha because it offers a better estimate of variance shared by the respected indicators, and because it uses the item loadings obtained within the nomological network (Hair *et al*., 2006; Karim, 2009). Furthermore, composite reliability is perceived as a stronger reliability assessment when compared to Cronbach's α, and is considered a more conservative test of reliability (Garver & Mentzer, 1999). As indicated in Table 3, the composite reliability scores for all scales exceed the minimum threshold level of 0.70 (Nunnally & Bernstein, 1994; Kline, 1998), thus indicating the reliability of the scales used in this study.

Although the previously mentioned item loadings and their significance appear to demonstrate convergent validity, we also assessed the convergent validity of our first-order constructs using Fornell & Larcker's (1981) average variance extracted (AVE) criterion. Based on Table 3, the AVE for each construct exceeds the minimum threshold value of 0.50 (Fornell & Larcker, 1981; Chin, 1998; Chin *et al*., 2003; Henseler *et al*., 2009). The combined results (i.e. the factor loadings and construct AVE values) provide the basis for our confidence that the reflective constructs in our research model demonstrate convergent validity.

Table 2. Factor loadings

Item	ERM	MKR	OITE	ITA
ERM1	**0.77**	0.46	0.41	0.46
ERM2	**0.84**	0.44	0.26	0.39
ERM3	**0.70**	0.36	0.22	0.36
MKR1	0.38	**0.82**	0.37	0.51
MKR2	0.46	**0.81**	0.40	0.52
MKR3	0.52	**0.83**	0.34	0.54
MKR4	0.33	**0.67**	0.34	0.35
MKR5	0.43	**0.86**	0.39	0.46
OITE1	0.35	0.46	**0.92**	0.50
OITE2	0.37	0.38	**0.91**	0.47
ITA1	0.47	0.57	0.47	**0.93**
ITA2	0.49	0.49	0.46	**0.87**
ITA3	0.33	0.33	0.46	**0.68**

ERM, External Relationship Management; MKR, Market Responsiveness; OITE, Operational IT Effectiveness; ITA, IT Alignment

Table 3. Correlation matrix and composite reliability (CR) scores for principal constructs

Construct	CR	AVE	ERM	MKR	OITE	ITA
External Relationship Management (ERM)	0.83	0.61	**0.78**			
Market Responsiveness (MKR)	–	–	0.54	–		
Operational IT Effectiveness (OITE)	0.91	0.84	0.39	0.46	**0.92**	
IT Alignment (ITA)	–	–	0.53	0.60	0.53	–

Items on the diagonal (in bold) represent the square root of the AVE scores.

We assessed discriminant validity of our reflective constructs via the cross loadings criterion (Chin, 1998; Chin *et al*., 2003) and AVE (Fornell & Larcker, 1981). According to the cross loading criterion (Chin, 1998; Chin *et al*., 2003), the loading of each indicator is expected to be greater than all of its cross loadings. Based on the cross loadings listed in Table 2, the criterion is satisfied. Based on the AVE, evidence of discriminant validity occurs when the square root of the AVE is greater than the correlations between constructs in the research model (Fornell & Larcker, 1981; Chin, 1998; Gefen *et al*., 2000; Gefen & Straub, 2005). The square root of the AVE for each first-order construct (bold diagonal elements in Table 3) is greater than its respective inter-construct correlations (off-diagonal elements in Table 3). These results suggest that the principal reflective constructs in our model demonstrate discriminant validity.

We assessed the validity of our formative constructs, operational IT effectiveness, market responsiveness and enterprise agility by examining the significance of the parameter estimates for each formative indicator. It has been argued that the parameter estimates of formative indicators can be interpreted as validity coefficients (Roberts and Thatcher, 2009). Table 4 details the parameter estimates and respective *t*-statistics for indicators of our formative constructs. Indicators for all formative constructs were significant, except for the IT alignment construct. Two of the three indicators for that construct significantly contribute to the IT alignment construct. Whereas some argue that non-significant indicators may not be valid measures of the construct (Diamantopoulos & Winklhofer, 2001), others suggest that it is acceptable to retain non-significant indicators if they contribute to the construct's content validity (Bollen & Lennox, 1991; Petter *et al*., 2007; Roberts & Thatcher, 2009). We chose to retain all three indicators that form the IT alignment construct to ensure sufficient breadth of coverage for capturing the content of the construct. This is important on a conceptual level, because eliminating an indicator could potentially result in a measure that captures only a portion of the IT alignment construct (Bollen & Lennox, 1991; Petter *et al*., 2007; Roberts & Thatcher, 2009). Hence, the nature of the construct would have been altered (Bollen & Lennox, 1991; Little *et al*., 1999; Petter *et al*., 2007; Roberts & Thatcher, 2009). In further support of our decision to retain the non-significant formative indicator, Petter *et al*. and Roberts and Thatcher intimate that conceptual considerations should always be taken into account when eliminating indicators.

Table 4. Parameter estimates for formative constructs

Construct	Item/construct	Weight	Standard error	*t*-statistic
Market responsiveness	MKR1	0.19	0.07	2.73**
	MKR2	0.29	0.05	4.93***
	MKR3	0.35	0.06	5.31***
	MKR4	0.16	0.06	3.09**
	MKR5	0.24	0.08	3.21**
IT alignment	ITA1	0.57	0.19	3.03**
	ITA2	0.39	0.23	1.75†
	ITA3	0.18	0.22	0.83
Enterprise agility	Market responsiveness	0.78	0.05	16.96***
	External relationship management	0.33	0.04	8.63***

Note: ***$p < 0.001$; **$p < 0.01$; †$p < 0.100$.

We used the variance inflation factor (VIF) statistic to assess the reliability of our formative measures. Scholars suggest that VIF values greater than 3.3 are a concern (Diamantopoulos & Siguaw, 2006; Petter *et al*., 2007; Roberts & Thatcher, 2009). The maximum VIF value for our formative indicators was 2.53, which is below the threshold of 3.3. Thus, multi-collinearity is not believed to pose a threat to our formative measures.

We conducted three tests to assess the extent of common method bias. First, we performed Harman's one-factor test by including all indicators in a principal components factor analysis (Podsakoff *et al*., 2003) and examining the unrotated factor solution to determine the number of factors that are necessary to account for the variance in the items. Using Harman's test, evidence for common method bias exists if either a single factor emerges or if one general factor accounts for the majority of the covariance among the items (Podsakoff *et al*., 2003; Pavlou *et al*., 2007). Our results show that neither case exists; therefore our data do not indicate evidence of substantial common method bias. Second, we employed Lindell & Whitney's (2001) partial correlation technique. This technique consists of using a theoretically unrelated construct (i.e. a marker variable) to adjust the correlations among the principal constructs. High correlations among any of the items of the study's principal constructs and the marker variable would indicate common method bias. We found no evidence of high correlations between the marker variable and our principal constructs. Third, we examined correlations between our variables. Our correlation matrix (see Table 3) does not indicate any highly correlated factors (highest correlation is $r = 0.60$), whereas evidence of common method bias would have resulted in extremely high correlations ($r > 0.90$) (Pavlou *et al*., 2007).

Results of hypothesis testing

We analysed the research model with SmartPLS 2.0 M3 (Ringle *et al*., 2005). SmartPLS is a path modelling tool that is well cited for highly complex predictive path models (Hennig-Thurau *et al*., 2007; Vance *et al*., 2008). For simplicity, we present the test results of our model in stages. We used the bootstrap resampling technique with 200 samples to estimate the

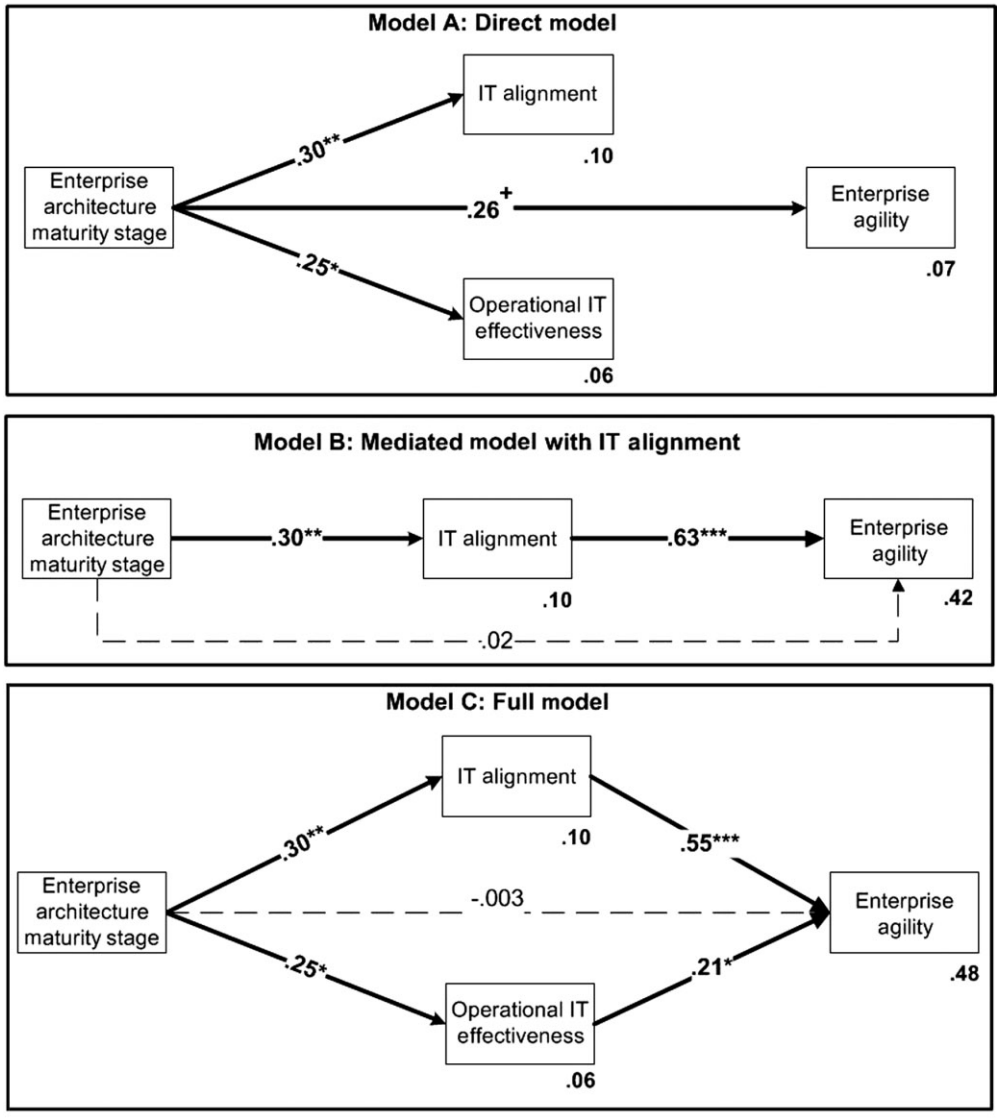

Figure 4. Research model results.
Note: ***$p < 0.001$; ** $p < 0.01$; * $p < 0.05$; + $p < 0.10$

significance of the path coefficients. The PLS path coefficients for the research model are in Figure 4. In accordance with prior studies, we tested the effects of all control variables on the latent variables in the research model, and since we found none of the effects to be significant, they are not shown in Figure 4.

First, Hypothesis 1 addressed the influence of the stage of EA maturity on perceived IT alignment. The results indicate that an increase in the stage of EA maturity has a significant and positive impact on perceptions of IT alignment (beta = 0.30, $p < 0.01$), thereby supporting Hypothesis 1 (see model A in Figure 4). Thus, as hospitals move from one stage of EA maturity to the next (e.g. from stage 1 to stage 2), perceptions of the level of IT alignment increase. Second, Hypothesis 2 examined the influence of EA maturity on perceived enterprise agility. The results indicate that the stage of EA maturity has a positive impact on perceptions of enterprise agility (beta = 0.26, $p < 0.10$) when the mediating effect of IT alignment on enterprise agility is not included in the model (see model A in Figure 4), thus supporting Hypothesis 2. Hence, as hospitals move from one stage of EA maturity to the next, perceptions about their ability to sense environmental change and respond readily increase. Hypothesis 3 dealt with the influence of EA maturity on perceived operational IT effectiveness. The results indicate that an increase in the stage of EA maturity has a positive effect on perceptions of operational IT effectiveness (beta = 0.25, $p < 0.05$), providing support for Hypothesis 3 (see model A in Figure 4). Thus, similar to the results of Hypothesis 2, as hospitals move from one stage of EA maturity to the next, perceptions about the operational impact of IT increase. Hypothesis 4 focused on the relationship between IT alignment and enterprise agility. Results indicate that perceptions about IT alignment have a positive impact on perceptions of enterprise agility (beta = 0.63, $p < 0.001$), thereby providing support for Hypothesis 4a (see Model B in Figure 4). Additionally, the results suggest that when we include the effect of IT alignment on enterprise agility in the model (see model B in Figure 4), the direct effect of EA maturity on enterprise agility is mediated (we discuss our examination of this further in the subsequent section), thus Hypothesis 4b is supported. Hypothesis 5 addressed the impact of perceived operational IT effectiveness on perceptions of enterprise agility. Results indicate that operational IT effectiveness has a significant and positive effect on perceptions of enterprise agility (beta = 0.21, $p < 0.05$), providing support for Hypothesis 5 (see model C in Figure 4). Hence, the degree to which the use of IT is believed to have an impact on hospital operations positively influences perceptions about hospitals' ability to sense and quickly respond to environmental changes.

Further examination of the mediating role of IT alignment

We hypothesised IT alignment to be a key mediator of the relationship between EA maturity and enterprise agility (H4b). To further explore this result, and to confirm our belief that IT alignment mediates the relationship between EA maturity and enterprise agility, we followed the steps recommended in prior studies (Baron & Kenny, 1986; Kenny *et al*., 1998) in establishing mediation. First, we established that there is a path that may be mediated by showing that the initial independent variable, EA maturity, has a significant effect on the dependent variable, enterprise agility ($\beta = 0.26$, $p < 0.10$; see model A in Figure 4). Second, we established that EA maturity has a significant effect on the proposed mediator, IT alignment ($\beta = 0.30$, $p < 0.01$; see model A in Figure 4). Third, we established that IT alignment has a

Table 5. Mediation results

Path	Mediator(s)	Indirect effect	f^2	ΔR^2
EA→ITA→AGIL	ITA	0.16**	0.60 (large)	0.35***

Note: $f^2 = (R^2_{incl} - R^2_{excl})/(1 - R^2_{incl})$; ***$p < 0.001$; **$p < 0.01$; *$p < 0.05$.
EA, Stage of Enterprise Architecture Maturity; ITA, IT Alignment; OITE, Operational IT Effectiveness; AGIL, Enterprise Agility.

significant effect on enterprise agility ($\beta = 0.63$, $p < 0.001$; see model B in Figure 4), while controlling for EA maturity ($\beta = 0.02$, not significant; see model B in Figure 4). Based on Kenny *et al*. (1998), when the aforementioned steps are met, we can conclude that IT alignment mediates the effect of EA maturity on enterprise agility. However, given that more recent studies (Preacher & Hayes, 2004; 2008) have questioned the Baron & Kenny (1986) approach, we also employed product of coefficients strategy (Sobel, 1982; Preacher & Hayes, 2004; 2008) as an added measure of robustness, relative to the testing of our mediation hypothesis.

Product of coefficients strategy is preferred over Baron & Kenny's (1986) casual step approach, because the number of inferential tests is minimised, thus reducing the likelihood of a Type 1 error (Preacher & Hayes, 2004; 2008). Furthermore, the product of coefficient approach does not rely on the assumption of a normal sampling distribution, which scholars suspect does not hold when mediation is present (Preacher & Hayes, 2004; 2008). As such, prior studies (Preacher & Hayes, 2004; 2008; Anagnostopoulos *et al*., 2010) recommend and use bootstrapping, a non-parametric re-sampling procedure to test the significance of the indirect effect in our model. In accord with the aforementioned studies, we conduct our mediation analysis with the latent variable scores obtained from our PLS analysis as input for the SPSS macros provided by Preacher & Hayes (2004; 2008).

Applying Sobel's test via the SPSS macro provided by Preacher & Hayes (2004), the bootstrap results indicated that the total effect of the stage of EA maturity on enterprise agility (total effect = 0.19, $p < 0.05$) became non-significant when IT alignment was included in the model (direct effect of the stage of EA maturity = 0.03, not significant). Furthermore, the analyses revealed, with 99% confidence, that the total indirect effect (i.e. the difference between the total and direct effects) of the stage of EA maturity on enterprise agility, through IT alignment, was significant with a point estimate of 0.16 and a 99% bootstrap confidence interval of 0.0073 to 0.3271. Because the 99% confidence interval does not contain zero, we can conclude that the indirect effect is significantly different from zero at $p < 0.01$ (Preacher & Hayes, 2004). Furthermore, the mediator's effect size (f^2) of 0.60 is large according to Cohen (1988) (e.g. f^2 values of 0.02, 0.15 and 0.35 are considered small, medium and large effects, respectively).Thus, we conclude that IT alignment fully mediates the relationship between the stage of EA maturity and enterprise agility. Additionally, the sign of the indirect effect is consistent with the interpretation that the stage of EA maturity has a positive impact on IT alignment, which in turn influences enterprise agility. Table 5 contains a summary of the results of our mediation analysis.

DISCUSSION AND CONCLUSION

In this paper, we proposed that EA influences IT alignment and the impact of IT use within a healthcare organisation and ultimately, increases the effectiveness of the hospitals' IT resources for achieving strategic goals. We then conducted a field survey of US hospitals in order to determine the degree and nature of the relationship between an organisation's stage of EA maturity and the organisational impact of its IT resources. Our results show that there is a significant relationship between a healthcare organisation's stage of EA maturity and the organisational impact of its IT resources. The higher the stage of EA maturity the organisation achieves, the more IT is perceived to improve organisational performance. We also found that the relationship between EA maturity and the organisational impact of IT is both direct and indirect in nature – we explain the details of this relationship below. Before delving into our key findings and their implications, we acknowledge some limitations that create opportunities for future research.

Limitations

As in the case with most empirical studies, our study is not free of limitations. The first limitation stems from our use of single-item self-classification to assign hospitals to a stage of EA maturity. Self-classification is probably the most common measurement method used for assigning organisations to a group or stage based on a variety of descriptors (Pleshko & Nickerson, 2006). Further, the use of single-item scales is generally viewed as defensible when they relate to a simple unidimensional construct, and can be measured with minimal measurement error (Conant *et al*., 1990). Yet, this method presents potential problems because organisations must be classified into one of the four stages, even though they may not share all of the requisite characteristics. This single-item, self-classification approach presents opportunity for future research. A comprehensive, multi-item measure for EA maturity is needed to more accurately classify organisations.

Another limitation of this study is the scarcity of hospitals in the fourth stage of the EA maturity model. The small percentage of US hospitals that have attained this stage can potentially present a challenge when attempting to assess whether the upward trajectory of the effects of EA maturity on IT resources will continue with the fourth stage or if the effects will begin to plateau. Although we would like to see more hospitals attain the fourth stage, we realise that their representation in this stage is tantamount to the percentage of organisations in the same stage across other industries (see Figure 2). Furthermore, others have gone on to interpret the results of their studies despite the small representation of organisations in the fourth stage (Ross, 2003; Ross *et al*., 2006). Therefore, we have no reason to believe that the small representation of organisations in the fourth stage will have a detrimental effect on the findings and implications of our study.

A third limitation of our study is the use of a single respondent for all measures. Although this technique is common in many disciplines, it creates a situation in which respondents might be motivated to make their organisation look as favourable as possible when it comes to how well

they are doing with IT, thus biasing their answers. However, the results of three separate tests of common method bias (i.e. Harman's one-factor test, Lindell and Whitney's partial correlation technique and correlation analysis) do not indicate evidence of substantial common method bias. Furthermore, we would have expected the presence of bias to influence the classification of EA maturity upward. Rather, Figure 2 suggests that the two lower stages of EA maturity have a greater percentage of hospitals than the two higher stages. To further temper concerns of respondent bias, it is worth noting the consistency between the percentage of hospitals in each stage of EA maturity and the percentage of non-healthcare organisations in the respective stages from a prior study (see Figure 2).

Lastly, we acknowledge that although we used previously validated scales for many of our multi-item constructs, there is still the potential for measures to be improved. More specifically, one of the formative items we adapted from Chan (2002) to measure IT alignment was not significant. Although we opted to retain that item to capture the full meaning of the IT alignment construct, future studies should seek to improve upon our measure of IT alignment.

Key findings, contributions and implications for research and practice

This study has three key findings, each of which has implications for both practitioners and researchers. First, the effectiveness of an organisation's IT resources is in harmony with its stage of EA maturity. Second, this study provides insight as to how an EA adds value to an organisation. Our findings indicate that EA adds value directly by way of its influence on both IT alignment and operational IT effectiveness. Third, it shows that EA indirectly influences enterprise agility, an impact that is mediated by IT alignment.

Our findings provide empirical support for the theory of EA as it relates to EA's strategic value as an IT resource and its ability to position an organisation for competitive advantage. Our results suggest that appropriate leveraging of IT resources can provide hospitals with competencies that are congruent with their competitive needs. As regulations and competition in the healthcare industry necessitate rapid changes, more hospitals will take on the characteristics of an entrepreneurial organisation. The stage of EA maturity positively influences the effectiveness of IT for clinical error detection and reduction, which is captured by operational IT effectiveness. Also, the stage of EA maturity positively influences the management of external relationships and market responsiveness, both of which are captured by enterprise agility. Finally, the stage of EA maturity positively influences IT–business partnership, which is captured by IT alignment. As such, EA maturity leads to an increase in competitive advantage via the additional digital options (Sambamurthy *et al.*, 2003) that become available for responding to changing regulatory and market conditions. Additionally, such hospitals besieged by competition and looking to invest more in their IT may need to look first at intermediate impacts such as operations, since these are more likely to be directly influenced by the stage of EA maturity, and thus, present the biggest influence on strategic and competitive advantage.

Additional empirical research and case studies would be useful for teasing out the relationships proposed in our model. This includes an assessment of the effects of all antecedent

variables on the first-order factors that we used as indicators to enterprise agility. This should hopefully provide insight as to whether our use of the second-order construct is masking the 'true' effects of the antecedent variables (i.e. EA, IT alignment and operational IT effectiveness). For instance, it is possible that IT alignment may not mediate EA's effect on both first-order constructs. Such research may also further corroborate whether the organisational benefits experienced by hospitals engaged in EA initiatives outweigh the costs associated with having a more mature EA.

We also identified IT alignment as a mediator of the stage of EA maturity's impact on enterprise agility. This result indicates that there is no direct relationship between EA maturity and enterprise agility, which would seem to indicate that the ultimate value of enterprise agility depends most closely on the ability to harness the maturity of a hospital's EA on the intermediate relationship (i.e. IT alignment). However, future research should examine more closely the intermediate impact in an effort to better understand the conditions under which EA maturity can best impact the mediating factor. Further, future studies could also investigate the mediating role of IT alignment on the relationship between EA stage of maturity and operational IT effectiveness, as well as the simultaneous mediating effect of both IT alignment and operational IT effectiveness on the relationship between EA maturity and enterprise agility. Such a study could provide insights as to whether operational IT effectiveness and enterprise agility are interdependent variables that together influence organisational performance or yield independent effects. The insights gained from this type of investigation could help researchers and practitioners recognise the disconnectedness or connectedness that exists between theory and practice, especially since the tendency of many hospitals is to pursue both strategic planning and operational implementation simultaneously and recursively rather than independently.

The adoption of health information technologies (HIT) is a global concern, and the USA lags behind other countries by at least a decade (Anderson *et al*., 2006). Perhaps, a future study could compare our findings on US hospitals with those of hospitals in other industrialised countries. An interesting comparison would be the US and Canada. Canada started its HIT initiatives in 1997, seven years before the USA established the Office of the National Coordinator of Health Information Technology, and expects to have electronic health records for half its population in the near future (Anderson *et al*., 2006). As an added benefit, testing our research model on a global scale could give us more hospitals that are in the fourth stage of EA maturity and validate the relationships between the stage of EA maturity and the effectiveness of IT resources.

Organisations are often hesitant to take on an EA initiative because it's time consuming and costly (Ross *et al*., 2006), and because they are unsure of the value EA would add to the organisation relative to the cost of implementation. By identifying the value EA adds, we hope to motivate organisations to undertake the initiative to develop their EA initially, as well as invest the resources (time, human and financial) to continue the maturation of their existing EA. Continual maturation of organisations' EA is especially necessary, particularly when you consider that the majority of hospitals in our study are classified as being in stage 2 of Ross's four-stage EA maturity model (see Figure 2).

We do not mean to imply that the benefits of EA maturity will always exceed the sometimes high costs of investing in enterprise architecture. However, previous studies have shown that many organisations have actually decreased their total IT expenditures by moving farther along the maturity scale. For example, organisations moving from stage 1 maturity to stage 2 lower their IT costs on average 15%, while organisations moving from stage 2 to stage 3 lower IT costs by an additional 10% (Ross *et al*., 2006). This is often due to the savings associated with moving distributed IT spending towards a more centralised IT strategy.

CONCLUSION

In the current study, we have shown that the benefit of investments in the maturity of a hospital's EA is at least partially through the impact this maturity has on both the effectiveness of IT operations and the alignment between IT and business plans, priorities and strategies. Organisations besieged by competition and looking to invest more in their IT may need to look first at intermediate impacts such as operations, since these are more likely to be directly influenced by the stage of EA maturity, and thus, present the biggest influence on strategic and competitive advantage. Additionally, our results suggest that appropriate leveraging of enhanced IT resources can provide hospitals with strategic competencies that are congruent with their competitive needs. As regulations and competition in the healthcare industry necessitate rapid changes, more hospitals will take on the characteristics of an entrepreneurial organisation. EA maturity endows these organisations with the strategic agility to take advantage of the opportunities presented by these changes. Whereas it is possible that there are other ways to impact both areas by other means, it is evident that increasing investments in EA is an option which should be strongly considered. Thus, healthcare organisations should not neglect their EA but rather should devote just as much time and energy to its quality and detail as they devote to other hospital endeavours.

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