IT infrastructure capability and health information exchange

DOI:
10.1007/978-3-030-04849-5_35

Document status and date:
Published: 01/01/2019

Document Version:
Publisher's PDF, also known as Version of record

Document license:
Taverne

IT Infrastructure Capability and Health Information Exchange: The Moderating Role of Electronic Medical Records' Reach: BIS 2018 International Workshops, Berlin, Germany, July 18–2...

Chapter · January 2019

DOI: 10.1007/978-3-030-04849-5_35

1 author:

Rogier van de Wetering
Open Universiteit Nederland

IT infrastructure capability and health information exchange: The moderating role of electronic medical records' reach

Rogier van de Wetering[1]

[1] Faculty of Management, Science and Technology, Open University of the Netherlands, Valkenburgerweg 177, 6419 AT Heerlen, the Netherlands
rogier.vandewetering@ou.nl

Abstract. This research investigates the hypothesized relationship between a hospital's IT infrastructure capability and the degree to which hospital can exchange health information. Enhanced information exchange within and between hospitals is currently considered to be critical for modern hospital operations in the big data era. In this research, we build on the resource-based view of the firm to position the deployment and usage of IT capabilities as a unique, valuable, appropriable and difficult-to-imitate resource of value for hospitals. Following the resource-based view of the firm, this study argues IT is a strategic source of value for hospitals. Guided by our research model we test two related hypotheses using Partial least squares (PLS)-based Structural Equation Modeling (SEM) on a large-scale cross-sectional dataset of 1155 European hospitals. Results show that IT infrastructure capability is a crucial antecedent of health information exchange. Finally, we found that the degree to which hospitals deploy hospital-wide systems that electronically maintain and share health data and information, i.e., Electronic Medical Records, influences the strength of this particular relationship. These particular findings suggest that although IT investments in hospitals continue to grow, IT plans and strategies to enable health information exchange will require ongoing attention. Hence, our research provides valuable insights into how IT can be targetted and exploited to support capabilities in clinical practice. Specifically, we demonstrate the conditions under which hospitals can leverage their IT resources to enhance levels of patient and health information exchange within the hospital and beyond its boundaries.

Keywords: IT infrastructure capability, health information exchange, PLS-MGA, IT capability, the resource-based view of the firm (RBV), hospitals.

1 Introduction

Modern hospitals currently deal with many interrelated and multi-faceted challenges, e.g., intense pressures to enhance clinical quality, take into account the dynamics of the changing environment, continuously need to innovate, change and collaborate and deal with quickly changing stakeholders wishes and demands. It seems only self-evident that hospital enterprises that want to be more competitive need to align their business operations and IS/IT resources. From extant literature has emerged the widely accepted conclusion that information technology (IT) can be beneficial for hospital enterprises to positively influence the health of individuals and the performance of providers [1, 2]. Therefore, hospitals are making substantial IT investments and look for appropriate digital strategies to cultivate the enterprise-wide adoption and usage of the systems that electronically maintain information concerning patients' individual's health status and care. Moreover, we now see that hospitals and other medical institutions are currently leveraging health IT to improve the quality of care, expand access, reduce operational costs, and enhance patient engagements [1, 3, 4]. In doing so, the management and decision-makers want to make sure that their resources and investments in IS/IT are harnessed successfully [5].

We currently see a trend toward rapid digitization of patient data and information and particular investment guided to engage in health information exchange (HIE) [6-8]. This development is partly also driven by regulatory pressures (e.g., the General Data Protection Regulation (GDPR). HIE allows hospitals to go beyond traditional silos within the organization and share clinical information, e.g., radiology reports, medical images, clinical documentation, and medication lists across the organizations' boundaries [9]. Therefore, this technology is getting center-stage in modern hospitals. Numerous studies highlight the value of HIE in clinical and administrative contexts. However, currently, we have a limited understanding of how hospitals can successfully leverage their IT investments, facilitate and enable HIE in a safe and privacy-minded context to create value.

Furthermore, the literature is not explicit about how hospitals can leverage and deploy HIE as a foundation to enhance quality and services benefits. The effective development and deployment of HIE in clinical practice require deliberate and targeted IT resource investments. However, few empirical studies examine the relationship between measures of IT resources and HIE. In addressing this particular issue, an IT infrastructure capability is widely recognized as a critical element to firm competitiveness and innovativeness [10-14]. Synthesizing from both Information System (IS) and health informatics studies over the past years [15-17], we see that having a flexible IT infrastructure capability is essential for organizations to enhance business processes, innovativeness and even competitiveness [10-14]. This capability underpins the formation of IT-enabled capabilities [18] and can be regarded as a key priority for organizations as they generate significant and sustainable performance enhancements.

Within this study, we draw upon the foundations of the resource-based view of the firm (RBV) [19, 20], to position the deployment and usage of IT as a unique and difficult-to-imitate resource of value for hospitals [17]. However, this source of value cannot operate on its own. For this paper, we follow Bharadwaj [21] and develop the concept of IT as a 'capability,' and empirically examine the degree to which an IT infrastructure capability drives HIE within hospitals. In line with this discussion, we also claim that this particular relationship is strengthened by the presence of an Electronic Medical record (EMR) that has enterprise-wide reach [22-26]. EMRs, in general, can be considered repositories of patient data in digital form, that store, and exchange data securely. Therefore, we guide our research through the following two research questions: '*To what extent does an IT infrastructure capability influence the formation of HIE within hospitals?*' moreover, '*Does the reach of an EMR influence the strength of this particular relationship?*'

We structured the remainder of this study as follows. Frist, we first review the literature on the RBV and IT infrastructure capabilities. These two aspects form the theoretical foundation of this work and strengthen our contribution to the IS community. Next, we propose the research model and the six hypotheses. In the coming section, we present the methods in and present the most important results. Finally, this work concludes with a discussion of the implications of the outcomes. We also identify inherent limitations and present various avenues for future research.

2 Theoretical background

2.1 IT infrastructure capability

The RBV is a contemporary strategy and management information systems (IS) theory that explains how organizations can obtain a competitive advantage as a result of the resources they own or have under their control [19, 20]. This theory gained a considerable research interest in research over the past years in IS studies and healthcare [5, 17, 27] and seemed to be a fitting lens for hospitals to leverage their IT resources. IS and RBV scholars acknowledge that it is imperative for organizations to identify those organizational capabilities that IT should target to address rapidly changing business environments [12, 13, 28]. Therefore, we build on the RBV and synthesize from the extant literature that an organization's IT infrastructure capability is a significant resource for process enhancement and competitive advantage. We can define an organization's IT infrastructure capability as an integrated set of reliable IT assets, resources, and services available to support both existing applications and new initiatives [29]. Extant literature asserted that such a capability could be refined into various quality attributes. These critical qualities include shareability and reusable across the organization [30], the degree to which standards and policies have been established and how applications connect and interoperate with each [31], and the level of integration of applications [10, 32]. Also, and business connectivity can be considered a quality through which an IT infrastructure capability can be assessed [10, 32]. Prior literature defined business connectivity through the infrastructure's particular i) reach and ii) range [10]. While reach primarily refers to interconnected locations, the range typically refers to the degree of encapsulated functionality (i.e., information and transaction processing) or services that share automatically.

2.2 Information sharing and health information exchange

During the late 80s and the beginning of the 90s scholars recognized that information sharing between organizations is essential in partnerships and collaborations between companies [33] and pivotal in achieving a competitive advantage. Scholars now elaborate on the benefits of sharing information in various markets and domains [34, 35]. Studies showcase that most of the benefits for the participants in information sharing relate to an enhancement of information provisioning to achieve business strategies, goals, enhanced efficiency of business processes and better network capabilities. Let us now turn to HIE, which in fact, is all about sharing and exchanging information in networked settings. HIE, thus, allows hospital enterprises to share securely and real-time use of health data and information [8] and enables providers to share and process health data and information among doctors, patients, and other stakeholders within the networked ecosystem. There is substantial evidence that HIE can improve hospital efficiency, reduce health care costs, and improve outcomes for patients [8, 36]. HIE, in that regard, can make a significant contribution to the process of generating a complete patient image.

3 Research model

3.1 IT infrastructure capability and HIE

Extant literature shows that an IT infrastructure capability can be a substantial resource for process enhancements and advantages in a competitive industry [10, 26, 37]. As such, this capability can be considered an integrated set of reliable IT assets, resources and services available to support both existing applications and new initiatives [29]. Studies highlighted the role and contribution of IT infrastructure capability on day-to-day business operations. For example, Duncan [30] demonstrated how infrastructure services could be directed toward the re-engineering of business processes using this capability. Therefore, this capability has great potential to improve operations within the hospital. HIE is considered to be critical for modern hospital operations as it enables hospitals to share and exchange clinical information. This particular aspects makes HIE a promising approach to improve resource utilization, and hence, improve the quality of healthcare delivery [9]. Typically, HIE exchanges vast amounts of patient information and data. It is, therefore, paramount that HIE is enabled by IT that supports both connectivity (i.e., hospital infrastructures reach and range, and level of standardization) [10, 11] and high levels of shareability and integration within the hospital [38]. In summary, if hospitals are equipped with a state-of-the-art IT infrastructure capability[1] and are efficient in targeting and deploying IT resources and assets, we foresee that they will display enhanced levels of HIE. Thus, we expect that IT infrastructure capability will positively influence IC and HIE. Hence, we suggest the following hypothesis:

Hypothesis 1. *IT infrastructure capability has a positive impact on HIE.*

3.2 The moderating role of EPDs' reach in health information exchange

Previous studies contend that EMRs are essential to essential to high-performing healthcare systems around the world [39-41]. EMRs can enhance doctors' standardized work practices, the availability of information, and the safety and quality of care, and enhances operational efficiency within and between hospitals, among many other benefits [39, 42, 43]. Although the use of EMR, in practice, seems promising, the outcomes and contribute to the quality of care have been challenged [44]. These systems are accessible by multiple authorized users within the hospital and beyond the boundaries of a hospital enterprise including other care institutions [45]. It is necessary to have clinical IS/IT capabilities and competencies in providers' setting to have EMRs efficaciously exchange (patient) information between providers [39, 43]. Thus, EMRs are a

[1] And thus also the associated IT-related investments.

crucial ingredient of hospitals IT portfolio. Motivated by prior literature on enterprise-wide EMR deployments and health IS maturity studies [22-25], we now contend that the presence of an enterprise-wide EMR will strengthen the impact of hospitals' IT infrastructure capability on HIE. This is not to say that hospitals that have multiple local, or departmental EMRs are not capable of sharing data. Notwithstanding, we argue that for hospitals to fully enable health data and information exchange, and leverage infrastructural investments, they need an enterprise-wide reach, so all the clinical service departments share its key functionality. This argument is also consistent with a claim made by Sambamurthy et al. [26] that high reach of IT is tightly associated with both the design and implementation of business operations that tie activities and information flows across the organization and beyond its boundaries. Therefore, we define:

Hypothesis 2. *The positive effect of IT infrastructure capability on HIE is moderated by EMRs' reach such that this positive effect is further strengthened when EMR's reach becomes high.*

4 Methods

4.1 Cross-sectional data collection

In this work, we follow a deductive approach. Therefore, we ground our work in theory, focus on facts, and craft persuasive arguments to substantiate our claims. To do so, we need a substantial amount of cross-sectional data from hospitals to test the two hypotheses. For this, we found a unique and large-scale dataset: European Hospital Survey: Benchmarking deployment of e-Health services (2012-2013)[2]. This survey covers a wide range of aspects from IT applications, technical infrastructure, information, and data exchange, security/privacy issues, IT functionalities. It benchmarks the level of eHealth adoption and uses in acute hospitals across 30 countries in Europe. In total 1,753 hospitals completed an interview. Interviews lasted on average 45 minutes, and the data collection team used Computer-Aided Telephone Interviewing (CATI) with native-speaking interviewers. The Benchmark was carried out by PwC EU Services, in cooperation with Global Data Collection Company (GDCC).

Given our primary aim and to make a justified assessment, this study focusses on those hospitals in our dataset that use EMRs for information sharing. Specifically, we want to know, whether or not, hospitals that have EMRs with enterprise-wide reach, are better equipped to drive HIE than hospitals that have local or departmental systems (see also section 3.2). Therefore, we removed cases that did not include EMRs that share information or do not use an EMR at all. Hence, we removed 598 cases in total. The final dataset included a total of 1155 hospitals, representing most of the European countries.

Finally, we applied Harman's single factor test (using SPSS v24) to control for common method bias (CMB). Hence, we could not identify a single factor that attributes to

---

[2] The survey is accessible through: https://ec.europa.eu/digital-single-market/en/news/european-hospital-survey-benchmarking-deployment-ehealth-services-2012-2013.

the majority of the variance. So, we can conclude that our sample is not affected by CMB [46].

4.2 Measurement items and construct development

Following established work, we now measure hospital's IT infrastructure capability (represented by a second-order construct) through (1) business connectivity and (2) IT assets, both modeled as first-order constructs. We measure the first latent construct through the level of I) standardization [31] (standards and policies establish how applications connect and interoperate with each other) and II) hospitals' infrastructures range and reach. We now follow the comprehensive operationalization by Broadbent et al. [10, 11]. Hence, we define this measure as the product of hospitals' reach of a computer system (from computers that are not part of a hospital-wide system toward systems are part of regional or national networks) and a broad range of services the hospital is managing. Our second latent construct, IT assets, is reflected by two indicators, i.e., I) the variety of critical applications (i.e., critical care information system (e.g., emergency, operating room), business intelligence, tele-homecare/telemonitoring services, medical/nursing document management system, appointment booking system, service order placing, transmission of clinical results and health events reporting system) and II) the degree to which applications within the hospital are integrated.

For HIE (our dependent first-order construct) we devised a set of four survey items from the European Hospital Survey. These questions are: does your hospital exchange electronically: (1) clinical care information about patients (for instance, clinical history or results from medical tests)? (2) laboratory results about patients? (3) medication lists information about patients? And (4) radiology images and reports about patients. Respondents could select multiple of the following answers: a) with a hospital or hospitals outside your hospital system, b) external general practitioners, c) external specialists, d) health care providers in other EU countries, e) health care providers outside the EU countries, f) other. All the above items were rescaled to a Likert scale from 1 to 5.

We measured the moderating variable, i.e., the presence of a hospital-wide EMR, using a binary scale. In our model all latent (first- and second-order) constructs are modeled reflectively, so manifest variables are affected by the latent variables [47, 48]. Hence, measurement items reflect and depict the construct.

5 Model estimation and results

We use a second generation Structural Equation Modeling (SEM), Partial least squares (PLS)-based technique, to evaluate the appropriateness of our research model [49]. PLS (or component-based SEM) algorithms estimate model parameters to maximize the variance explained for all endogenous constructs in the model through a series of ordinary least squares (OLS) regressions, depending on the model specification [48, 50, 51]. The usage of PLS fits an integrative mode of thinking about theory construction, measurement problems, and data analysis. We use SmartPLS version 3.2.7. [52] for model estimations. Also, we used a non-parametric bootstrapping procedure [51] (with

500 replications) to compute the significance levels of the regression coefficients. Our sample of 1155 responses exceeds all minimum requirements concerning the measurement and structural model.

5.1 Analyses of the measurement model

We subjected our first-order constructs to internal consistency reliability, convergent validity, and discriminant validity tests through SmartPLS [52] to assess the psychometric model properties. Hence, we computed the composite reliability (CR)[3] values for each construct and established that their values were above the threshold of 0.70. Table 1 shows that all our CR values are above the threshold. We also assessed the obtained construct-to-item loadings. Our model did not contain any indicators with a loading of less than 0.6. Next, we assessed convergent validity by examining if the average variance extracted (AVE) is above the generally accepted lower limit of 0.50. All our calculated AVE values exceed the minimum threshold value. In a subsequent step, we assessed discriminant validity. First, we assessed if the cross-loadings on other constructs are less than the outer loading on the associated construct. Second, we assessed the Fornell-Larcker criterion. In doing so, we investigated if the square root of the AVEs was substantially larger than the inter-construct correlations [47] (see entries in bold in Table 1 along the matrix diagonal). All square root values are higher than the shared variances of the constructs with other constructs in the model. We found further evidence of discriminant validity by using the relatively new heterotrait-monotrait (HTMT) ratio of correlations approach by Henseler, Ringle, & Sarstedt [53].

Table 1. Assessment of reliability, convergent and discriminant validity of reflective constructs

	1	2	3
1. Business connectivity	**0.759**		
2. IT assets	0.353	**0.848**	
3. Health information exchange	0.263	0.413	**0.806**
AVE	0.577	0.720	0.649
Composite reliability	0.731	0.837	0.880

PLS calculates this ratio based on the mean of the correlations of indicators across constructs measuring different constructs, relative to the average correlations of indicators within the same construct. All values are well below the upper bound (HTMT ratio value ≤ 0.90).

5.2 Analyses of the structural model

To test our two hypotheses, we estimated the structural model using the PLS algorithm and an additional non-parametric multi-group analysis (PLS-MGA) [54]. In these analyses, we mainly investigated the significance and association of each hypothesized

[3] Composite reliability is similar to Cronbach's alpha without the assumption of the equal weighting of variables.

path and the coefficient of determination (R^2); a measure of the model's predictive power.

Results show that hospital's IT infrastructure significantly influences HIE (β = 0.428; t = 15.815; p < 0.0001), thereby confirming our first hypothesis. The model shows a substantial coefficient of determination, $R^2 = 0.181$. During the structural analyses we controlled our model for 'size' (amount of beds), 'hospital type' (private or public) and 'IT budget' all showing non-significant effects. For our second hypothesis, we employ a regression-based approach to test the effects of categorical moderating variables [55]. Therefore, we divided our dataset into two separate groups following [49], i.e., (1) N = 843 (hospital-wide EMR shared by all clinical service departments) and (2) N = 312 (multiple local/departmental EMRs) and statistically assessed the difference between the same parameter estimates but for the two distinct groups [54]. We employed the PLS-MGA algorithm in SmartPLS to execute this particular analysis. Outcomes show a statistically significant difference (p = 0.028)[4] between the assessed groups. The results for the separate path model analyses are as follows. Group 1 (β = 0.459, t = 8.460, p < 0.001) shows a significantly higher path coefficient than this particular estimate in group 2 (β = 0.333, t = 8.460, p < 0.001). As we expected, the model run for group 1 explains 21.5% of the variance for HIE. More so, the model's inner model for group two has an $R^2 = 0.118$. These outcomes, thereby confirm our second hypothesis.

6 Discussion, conclusions, and limitations

Drawing on the RBV, this study empirically examined the degree to which an IT infrastructure capability drives HIE within hospitals. For this, we used data from a large-scale cross-sectional survey, distributed by the European Commission. We argued that hospitals that are equipped with a state-of-the-art IT infrastructure capability would display enhanced levels of HIE. Moreover, we corroborated that this effect would be even stronger for a hospital that uses an EMR with enterprise-wide reach. We found support for our hypotheses and thus our essential claims through the use of various PLS model estimations and analyses. Therefore, hospitals' IT infrastructure capability has great potential to improve HIE operations within the hospital. It, now, also goes without saying that hospitals can leverage their HIE potential by providing an enterprise-wide reach for EMRs.

Like all research, our research is constrained by some limitations. Hence, the outcomes need to be interpreted with caution. First, we only included IT infrastructure capability as an antecedent in our research model. Driven by other IS studies [13, 14, 21, 56], it likely the case that other capabilities, organizational aspects, and condition factors influence HIE in practice. Second, we did not compare groups (and types) of hospitals across countries. Such an analysis would contribute to the generalizability of our findings. Finally, we did not investigate the specific subgroups in detail.

To conclude, our study contributes to the literature by unfolding specific conditions under which hospitals can leverage their IT resources and capabilities to enhance levels

[4]At the 5% probability of error level.

of patient and health information exchange within the hospital and beyond its boundaries. Outcomes of this research are likewise relevant for practitioners as these outcomes can help decision-makers in the process of efficiently allocating IT resources, mature their IT infrastructure, and make purposeful IT investments.

References

1. Buntin, M.B., et al., *The benefits of health information technology: a review of the recent literature shows predominantly positive results.* Health affairs, 2011. **30**(3): p. 464-471.
2. Kohli, R. and S.S.-L. Tan, *Electronic health records: how can IS researchers contribute to transforming healthcare?* Mis Quarterly, 2016. **40**(3): p. 553-573.
3. Sheikh, A., H.S. Sood, and D.W. Bates, *Leveraging health information technology to achieve the "triple aim" of healthcare reform.* Journal of the American Medical Informatics Association, 2015. **22**(4): p. 849-856.
4. Hendrikx, H., et al., *Expectations and attitudes in eHealth: A survey among patients of Dutch private healthcare organizations.* International Journal of Healthcare Management, 2013. **6**(4): p. 263-268.
5. Van de Wetering, R., J. Versendaal, and P. Walraven. *Examining the relationship between a hospital's IT infrastructure capability and digital capabilities: a resource-based perspective*, in the Proceedings of the *Twenty-fourth Americas Conference on Information Systems (AMCIS)*. 2018. New Orleans: AIS.
6. Van de Wetering, R. and J. Versendaal. *How a flexible collaboration infrastructure impacts healthcare information exchange*, in the Proceedings of the *31th Bled eConference Digital Transformation – Meeting the Challenges*. 2018. Bled, Slovenia.
7. Walker, J., et al., *The value of health care information exchange and interoperability.* Health affairs, 2005. **24**: p. W5.
8. Hersh, W.R., et al., *Outcomes from health information exchange: systematic review and future research needs.* JMIR medical informatics, 2015. **3**(4).
9. Vest, J.R., et al., *Challenges, alternatives, and paths to sustainability for health information exchange efforts.* Journal of Medical Systems, 2013. **37**(6): p. 9987.
10. Broadbent, M., P. Weill, and B.-S. Neo, *Strategic context and patterns of IT infrastructure capability.* The Journal of Strategic Information Systems, 1999. **8**(2): p. 157-187.
11. Weill, P., M. Subramani, and M. Broadbent, *Building IT infrastructure for strategic agility.* MIT Sloan Management Review, 2002. **44**(1): p. 57.
12. Mikalef, P., A. Pateli, and R. van de Wetering, *IT flexibility and competitive performance: The mediating role of IT-enabled dynamic capabilities*, in the Proceedings of the *24th European Conference on Information Systems (ECIS)*. 2016.
13. Van de Wetering, R., P. Mikalef, and A. Pateli. *A strategic alignment model for IT flexibility and dynamic capabilities: toward an assessment tool*, in the

Proceedings of the *Twenty-Fifth European Conference on Information Systems (ECIS)*. 2017. Guimarães, Portugal.

14. Van de Wetering, R., P. Mikalef, and R. Helms, *Driving organizational sustainability-oriented innovation capabilities: a complex adaptive systems perspective.* Current Opinion in Environmental Sustainability, 2017. **28**: p. 71-79.
15. Henderson, J.C. and N. Venkatraman, *Strategic alignment: leveraging information technology for transforming organisations.* IBM Systems Journal, 1993. **32**(1): p. 4–16.
16. Melville, N., K. Kraemer, and V. Gurbaxani, *Review: Information technology and organizational performance: An integrative model of IT business value.* MIS quarterly, 2004. **28**(2): p. 283-322.
17. Wade, M. and J. Hulland, *Review: The resource-based view and information systems research: Review, extension, and suggestions for future research.* MIS quarterly, 2004. **28**(1): p. 107-142.
18. El Sawy, O.A. and P.A. Pavlou, *IT-enabled business capabilities for turbulent environments.* MIS Quarterly Executive (2008), 2008. **7**(3): p. 139-150.
19. Barney, J., *Firm resources and sustained competitive advantage.* Journal of management, 1991. **17**(1): p. 99-120.
20. Wernerfelt, B., *A resource-based view of the firm.* Strategic Management Journal, 1984. **5**(2): p. 171–180.
21. Bharadwaj, A.S., *A resource-based perspective on information technology capability and firm performance: an empirical investigation.* MIS quarterly, 2000: p. 169-196.
22. Siegel, E.L. and B. Reiner, *Filmless radiology at the Baltimore VA Medical Center: a 9 year retrospective.* Computerized Medical Imaging and Graphics, 2003. **27**: p. 101–109.
23. Van de Wetering, R. and R.S. Batenburg, *A PACS maturity model: a systematic meta-analytic review on maturation and evolvability of PACS in the hospital enterprise.* International Journal of Medical Informatics, 2009. **78**(2): p. 127–140.
24. Evans, D.C., W.P. Nichol, and J.B. Perlin, *Effect of the implementation of an enterprise-wide Electronic Health Record on productivity in the Veterans Health Administration.* Health Economics, Policy and Law, 2006. **1**(2): p. 163-169.
25. Carvalho, J.V., et al., *A Maturity model for hospital information systems.* Journal of Business Research, 2017.
26. Sambamurthy, V., A. Bharadwaj, and V. Grover, *Shaping agility through digital options: Reconceptualizing the role of information technology in contemporary firms.* MIS quarterly, 2003: p. 237-263.
27. Gordon, S.R. and M. Tarafdar, *How do a company's information technology competences influence its ability to innovate?* Journal of Enterprise Information Management, 2007. **20**(3): p. 271-290.
28. Kohli, R. and V. Grover, *Business value of IT: An essay on expanding research directions to keep up with the times.* Journal of the association for information systems, 2008. **9**(1): p. 23.

29. Weill, P. and M. Vitale, *What IT infrastructure capabilities are needed to implement e-business models?* Mis Quarterly, 2002. **1**(1): p. 17.
30. Duncan, N.B., *Capturing flexibility of information technology infrastructure: A study of resource characteristics and their measure.* Journal of Management Information Systems, 1995: p. 37-57.
31. Weill, P. and J. Ross, *A matrixed approach to designing IT governance.* MIT Sloan Management Review, 2005. **46**(2): p. 26.
32. Broadbent, M. and P. Weill, *Management by maxim: how business and IT managers can create IT infrastructures.* MIT Sloan Management Review, 1997. **38**(3): p. 77.
33. Konsynski, B.R. and F.W. McFarlan, *Information partnerships--shared data, shared scale.* Harvard Business Review, 1990. **68**(5): p. 114-120.
34. Lotfi, Z., et al., *Information sharing in supply chain management.* Procedia Technology, 2013. **11**: p. 298-304.
35. Bagheri, S., et al., *Classification framework of knowledge transfer issues across value networks.* Procedia CIRP, 2016. **47**: p. 382-387.
36. Patel, V., et al., *Physicians' potential use and preferences related to health information exchange.* International journal of medical informatics, 2011. **80**(3): p. 171-180.
37. Overby, E., A. Bharadwaj, and V. Sambamurthy, *Enterprise agility and the enabling role of information technology.* European Journal of Information Systems, 2006. **15**(2): p. 120-131.
38. Ross, J.W., C.M. Beath, and D.L. Goodhue, *Develop long-term competitiveness through IT assets.* Sloan management review, 1996. **38**(1): p. 31.
39. Jaana, M., M.M. Ward, and J.A. Bahensky, *EMRs and clinical IS implementation in hospitals: a statewide survey.* The Journal of Rural Health, 2012. **28**(1): p. 34-43.
40. Sittig, D.F., D. Gonzalez, and H. Singh, *Contingency planning for electronic health record-based care continuity: a survey of recommended practices.* International journal of medical informatics, 2014. **83**(11): p. 797-804.
41. DesRoches, C.M., et al., *Adoption of electronic health records grows rapidly, but fewer than half of US hospitals had at least a basic system in 2012.* Health Affairs, 2013: p. 10.1377/hlthaff. 2013.0308.
42. Park, S.Y., S.Y. Lee, and Y. Chen, *The effects of EMR deployment on doctors' work practices: A qualitative study in the emergency department of a teaching hospital.* International journal of medical informatics, 2012. **81**(3): p. 204-217.
43. Boonstra, A. and M. Broekhuis, *Barriers to the acceptance of electronic medical records by physicians from systematic review to taxonomy and interventions.* BMC health services research, 2010. **10**(1): p. 231.
44. Zhou, L., et al., *The relationship between electronic health record use and quality of care over time.* Journal of the American Medical Informatics Association, 2009. **16**(4): p. 457-464.
45. Häyrinen, K., K. Saranto, and P. Nykänen, *Definition, structure, content, use and impacts of electronic health records: a review of the research literature.* International journal of medical informatics, 2008. **77**(5): p. 291-304.

46. Podsakoff, P.M., et al., *Common method biases in behavioral research: A critical review of the literature and recommended remedies.* Journal of applied psychology, 2003. **88**(5): p. 879.
47. Chin, W., *Issues and opinion on structural equation modeling.* Management Information Systems Quarterly, 1998. **22**(1): p. 7–16.
48. Wetzels, M., G. Odekerken-Schröder, and C. Van Oppen, *Using PLS path modeling for assessing hierarchical construct models: guidelines and empirical illustration.* MIS Quarterly, 2009. **33**(1): p. 177–195.
49. Hair Jr, J.F., et al., *A primer on partial least squares structural equation modeling (PLS-SEM)*. 2016: Sage Publications.
50. Reinartz, W., M. Haenlein, and J. Henseler, *An empirical comparison of the efficacy of covariance-based and variance-based SEM.* International Journal of Research in Marketing, 2009. **26**(4): p. 332–344.
51. Tenenhaus, M., et al., *PLS path modeling.* Computational Statistics & Data Analysis, 2005. **48**(1): p. 159–205.
52. Ringle, C.M., S. Wende, and J.-M. Becker, *SmartPLS 3.* Boenningstedt: SmartPLS GmbH, http://www. smartpls. com, 2015.
53. Henseler, J., C.M. Ringle, and M. Sarstedt, *A new criterion for assessing discriminant validity in variance-based structural equation modeling.* Journal of the Academy of Marketing Science, 2015. **43**(1): p. 115-135.
54. Henseler, J., C. Ringle, and R. Sinkovics, *The use of partial least squares path modeling in international marketing.* Advances in International Marketing, 2009. **20**(2009): p. 277-319.
55. Baron, R.M. and D.A. Kenny, *The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations.* Journal of personality and social psychology, 1986. **51**(6): p. 1173.
56. Chen, Y., et al., *IT capability and organizational performance: the roles of business process agility and environmental factors.* European Journal of Information Systems, 2014. **23**(3): p. 326-342.