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### Recommended Citation

van de Wetering, Rogier and Versendaal, Johan, "How a flexible collaboration infrastructure impacts healthcare information exchange" (2018). *BLED 2018 Proceedings*. 12.

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## How a flexible collaboration infrastructure impacts healthcare information exchange

ROGIER VAN DE WETERING & JOHAN VERSENDAAL

**Abstract** Exchanging health information and data is considered to be critical for modern hospital operations. Research shows that exchanging, e.g., laboratory results, clinical summaries, and medication lists, across the boundaries of hospitals, will improve the efficiency, quality, cost-effectiveness, and even safety of healthcare practices. However, views and strategies differ on how hospitals can facilitate or enable this exchange process, given the high dynamics of technology and IT developments. We explore a hypothesized relationship between a flexible collaboration infrastructure and health information and data exchange. This study builds on the resource-based view of the firm and subsequently tests two hypotheses using PLS-SEM analysis on a sample of 983 European hospitals. We find that there is a significant positive relationship between flexible collaboration infrastructures and health information and data exchange. Hospitals' security measures to protect the confidentiality, integrity, and availability of the data conditions this relationship.

**Keywords:** • Flexible collaboration infrastructure • IT flexibility • Health information and data exchange (HIDE) • PLS-MGA • Data security • Electronic Medical record (EMR) •

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DOI <https://doi.org/10.18690/978-961-286-170-4.30>

ISBN 978-961-286-170-4

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Available at: <http://press.um.si>

## 1 Introduction

Organizations currently explore and exploit new digital strategies and innovative technologies to survive in competitive and turbulent markets (Lyytinen, Yoo, & Boland Jr, 2016; Mithas, Tafti, & Mitchell, 2013). This trend also holds for the healthcare sector and hospitals in particular (Blumenthal, 2010; Hendriks, Pippel, Van de Wetering, & Batenburg, 2013; Kohli & Tan, 2016). To this end, hospitals are in need of having real-time healthcare information and (patient) data (Hersh et al., 2015; Vest, Campion, Kaushal, & Investigators, 2013). Driven, also, by various mandatory requirements, we see a trend toward rapid digitization of large amounts of patient data. This digitization is often complemented with the capability of compiling and electronically exchanging interoperable data with other providers within the ecosystem (Walker, Pan, Johnston, & Adler-Milstein, 2005).

Health information and data exchange (HIDE) enables hospitals to share clinical information, e.g., laboratory results, physician documentation, and medication lists across the organizations' boundaries (Vest et al., 2013). HIDE can boost efficiency, reduce health care costs, and improve outcomes for patients (Hersh et al., 2015). Therefore, many hospitals are considering the adoption and use HIDE as a source of value (Patel, Abramson, Edwards, Malhotra, & Kaushal, 2011; Walker et al., 2005). The recent attention to patient privacy (strengthened by the European General Data Regulation and Protection, GDPR, regulations) and systems security complement these observations. Up until now, in practice, views differ on how hospitals can facilitate and enable HIDE in a safe and privacy-minded context, using specific IT configurations. Let alone, how the hospital, within the broader hospital ecosystem can leverage and deploy this strategic competence to enhance quality and services benefits. Typical collaboration systems and infrastructures do not adequately support organizations and business networks to exchange, use and leverage resources (Begole, Rosson, & Shaffer, 1999; Byrd & Turner, 2000). Flexible infrastructure configurations are considered a critical component to adapt and reconfigure IT architectures strategically and operationally, also in healthcare (Bhatt & Grover, 2005; Kung, Wang, & Kung, 2016). HIDE, however, is still in the early adoption phase (Patel et al., 2011). Gartner classified HIDE as a real-time health system technology that is currently beyond the peak of inflated expectations and is now sliding through (Runyon & Pessin, 2017). Therefore, Gartner analysts observed inconsistent results from this technology and implementations often fail to deliver (Runyon & Pessin, 2017). Thus, the full potential of HIDE in practice currently remains mostly unrealized even as mature IS/IT can provide patients with instantaneous information from anywhere and anyone (Carvalho, Rocha, van de Wetering, & Abreu, 2017; Patel et al., 2011).

This study builds on both the shortcomings and foundations of previous HIDE investigations. We mainly focus on the question whether, and if so, to what extent a hospital's flexible collaboration infrastructure (as of now: FCI) influences HIDE. We derive the notion of FCI in this study from various relevant IT capabilities, i.e., IT flexibility and collaborative studies and perspectives (Broadbent, Weill, & Neo, 1999; Camarinha-Matos, Afsarmanesh, Galeano, & Molina, 2009; Duncan, 1995; Österle,

Fleisch, & Alt, 2012; Weill & Vitale, 2002). Therefore, we consider hospitals' FCI as an integrated set of reliable IT assets and networking functionalities that support existing applications and anticipate and enable new possibilities with a nexus of relationships that can be forged within the hospital ecosystem. In practice, naturally, the exchange of health data should be accompanied by fitting security measures and procedures that contribute to confidentiality, integrity, availability, and timeliness of health information and patient's data (Benharref & Serhani, 2014; Fedorowicz & Ray, 2004; Sahama, Simpson, & Lane, 2013).

We draw upon the resource-based view of the firms (RBV) (Barney, 1991) as our theory base. This theory provides a solid foundation to think about how IT contributes to organizational benefits and value creation (Wade & Hulland, 2004). Given the above, we drive this research by the following questions: '*What is the impact of a hospital's FCI on HIDE?*' and '*What is the conditioning effect of deployed hospital's security measures on this particular relationship?*'

We have structured this paper as follows. First, we review theoretical aspects relevant to this study, propose our research model and develop hypotheses. The methods and results section then follows these sections. We end with main findings, discussions, inherent limitations of this study and we outline future research opportunities.

## **2 Research model and hypotheses**

### **2.1 The resource-based view of the firm**

The RBV is an acknowledged theory within the management domain as well as within the IS community. The RBV explains how organizations achieve a competitive advantage as a result of the resources they own or have under their control (Barney, 1991). Scholars apply this resource-based theory as a foundation in the IS context through the notion of single IT resources, sets of IT resources and IT capabilities (Bhatt & Grover, 2005; Wade & Hulland, 2004). The central premise of the RBV within the context of IT is that only investing in IT is insufficient to enhance competitive performance (Caldeira & Ward, 2003; Wade & Hulland, 2004). We follow this so-called 'resource-based' line of reasoning and argue that an IT infrastructure—that is both flexible and supports collaboration functionality—is deemed appropriate to target IT resources to efficiently exchange health information and data within and between hospitals.

### **2.2 Flexible collaboration infrastructure**

Past literature proposed that IT infrastructure flexibility is a new competitive weapon that determines the value of that infrastructure to organizations (Byrd & Turner, 2000). IT flexibility supports organizations to get sustained organizational advantage and even accommodates frequent business change, albeit to some extent (Mikalef, Pateli, & van de Wetering, 2016; Tafti, Mithas, & Krishnan, 2013; R. Van de Wetering, Mikalef, & Pateli, 2017). Although flexible IT infrastructures can efficaciously alter the way hospitals

exchange information, it is conceivable—following the RBV theoretic lens—that this aspect without the presence of complementary networking and collaboration assets, resources and capabilities is not sufficient to enable the process of HIDE. Collaborating organizations have become the ‘new normal’ in current dynamic markets to innovate, change and collaborate (Grefen, 2013). Within the literature on collaborative networks, information sharing is hardly addressed and mostly taken for granted, while these types of collaborations typically require fine-grained harmonization between resources (Grefen et al., 2009). IT-enabled collaborative capabilities form a foundation for an organization’s ability to improve boundary spanning capabilities (Dewett & Jones, 2001; Gnyawali & Park, 2011) and thus also the exchange of data resources. Synthesizing from the above, we see the value and contribution of FCI in facilitating cross-enterprise HIDE. Following (Broadbent et al., 1999; Byrd & Turner, 2000; Camarinha-Matos et al., 2009; Duncan, 1995; Österle et al., 2012; Termeer & Bruinsma, 2016; Rogier van de Wetering, Mikalef, & Helms, 2017; Weill & Vitale, 2002) we represent FCI through two core dimensions, i.e., 1) IT flexibility and 2) collaborative networking assets. We expect that the process of exchanging health information mainly depends on a) the ability to flexibly anticipate on changes in circumstances and context, and b) the ability of interaction and collaboration with other providers, like other hospitals, external general practitioners, external specialists, and health care providers, even in other countries. Hospitals are becoming more aware that HIDE and other types of IT-enabled innovations promote patient, clinical as well as add social and organizational value by extending organizational boundaries and collaborating with multiple entities. Hence, we define:

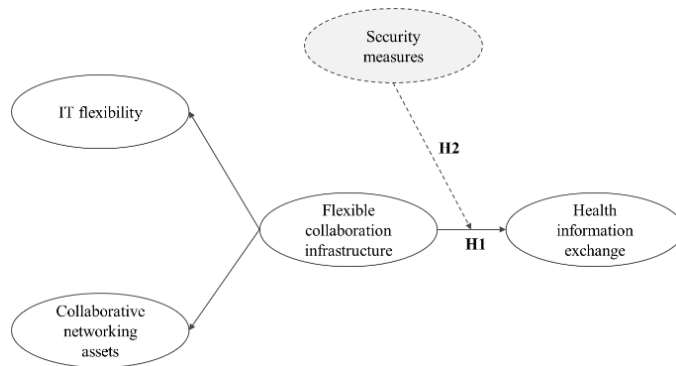
**Hypothesis 1:** *FCIs within hospitals positively influences HIDE.*

### 2.3 Security and privacy

Conditions under which IT infrastructure capabilities and FCIs in particular add value have been a subject of much debate. Despite the enormous potential gains, there could be obstacles that impair the diffusion of IT, its adoption, usage and its performance contributions. Among those barriers are the perceived threats to the security and privacy of patients’ health information and data (Sahama et al., 2013). Therefore, many countries around the world now working on legislative regulation of HIDE (in Europe: GDPR). In the meantime, adequate security measures and procedures within hospitals could contribute to confidentiality, integrity, availability, and timeliness of health information and patient’s data (Benharref & Serhani, 2014; Fedorowicz & Ray, 2004; Sahama et al., 2013). However, much ambiguity remains concerning the influence of security measures on HIDE. Securing sensitive health data is an enormous challenge. It is in this process that we foresee that hospitals that heavily invest in security and privacy measures will be better equipped to facilitate HIDE. Hence, we propose:

**Hypothesis 2.** *The degree to which hospitals deploy security measures—to protect patient data stored and transmitted by the hospital’s IT system—influences the strength of the relationship between the FCI and HIDE.*

Figure 1 summarizes our research model and the associated hypotheses.



**Figure 1: Research model and hypotheses**

### 3 Research methods

#### 3.1 Design and sample

To address our research questions, we need a substantial cross-sectional data sample containing considerable variation in technical, organizational and data (and information) capability measurements. Therefore, we used a unique, comprehensive cross-sectional dataset—from the European Hospital Survey: Benchmarking deployment of e-Health services (2012-2013)—to test our hypotheses. This dataset contains about 1,800 hospitals across 30 countries within Europe. In this survey, data were obtained from representative sample of European acute hospitals to benchmark their level of eHealth and medical IT deployment and take-up of ICT and eHealth applications. Therefore, the survey categories and questions and cover a wide range of aspects from IT infrastructure, IT applications, exchange of health data and information, and security and privacy issues. Initial pilots contributed to the quality of the survey. The final questionnaire was in most cases completed by chief information officers (CIOs), IT managers (directors) and Chief operating officer (COO) / Operations Manager.

We performed Harman’s single factor test using SPSS v24 on the included constructs in our study to control for common method bias (CMB). We found that one factor could not attribute the majority of variance (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). Therefore, our data and results are not affected by CMB.

Within our current scope, we only focused on the hospitals within our sample that use Electronic Medical Records (EMRs) for HIDE either through i) a hospital-wide EMR (shared by all clinical service departments), or ii) multiple local/departmental EMR systems which share information with a central EMR. EMRs integrate a wide variety of modules and IT components within the hospital enterprise to integrally and centrally

collect, store and distribute patient health information (DesRoches et al., 2013). Thus, based on the concepts within our research model and to govern the data quality (due to missing values), we conservatively removed 768 cases. We included 983 hospitals in the final analyses.

### 3.2 Measurement

Each of the included operationalized latent constructs in our study are inspired based on past empirical and validated work, as initially presented in section 2.1. IT flexibility, can be broadly considered as the degree of decomposition of an organization's IT portfolio into loosely coupled subsystems that communicate through standardized interfaces (Byrd & Turner, 2000; Mikalef et al., 2016). Accordingly, we operationalized this quality through I) the degree of standardization—referring to established standards/policies on how applications connect and interoperate with each other (Weill & Ross, 2005)—and II) the degree to which applications are integrated. Standardization and thus also the standards the hospitals' systems support or comply with (e.g., HL7, IHE integration profiles, DICOM) and system integration are vital for HIDE to achieve its goal.

We adopt two critical indicators for hospital's collaborative networking assets, i.e., i) hospitals' reach of a computer system (from personal computers that are not part of a hospital-wide system toward systems are part of regional or national networks as reach refers to locations) (Broadbent et al., 1999; Dewett & Jones, 2001; Termeer & Bruinsma, 2016) and ii) the degree to which also patients—as an important stakeholder in this context—have online access to their records (Kruse, Bolton, & Freriks, 2015). Finally, we operationalized HIDE as a latent construct containing the following measures 12 measurements<sup>36</sup>. All items were measured on or rescaled to a Likert scale from 1 to 5 (not in place – fully implemented), apart from our moderating variable security measures. We operationalized<sup>37</sup> security measures using a binary scale based on theoretically appealing cutpoints (Baron & Kenny, 1986; Sauer & Dick, 1993). Therefore, group 1 (N = 482) represents low-security measures (cumulative scores 1 and 2) and group 2 (N = 501) represents high-security measures (cumulative scores 3 to 6). Together, they form representative groups of equal size.

This study incorporates the control variable 'hospital type.'

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<sup>36</sup> 1) patient interaction, 2) make appointments at other care providers, 3) send/receive referral and discharge letters, 4) transfer prescriptions to pharmacists, 5) exchange medical patient data, 6) receive laboratory reports and 7) share them with other healthcare professionals, 8) exchange patient medication lists with healthcare professionals / providers, 9) exchange radiology reports, 10) exchange medical patient data, 11) certify sick leaves and 12) certify disabilities.

<sup>37</sup> This question contained multiple possible answers: (i) encryption of stored data, (ii) Encryption of transmitted data, (iii) workstations with access through health professional cards, (iv) workstations with access through fingerprint information, (v) workstations with access through a password, (vi) data entry certified with digital signature





## 4 Model assessment

We use PLS (Partial least squares)-SEM to assess our research model (Hair Jr, Hult, Ringle, & Sarstedt, 2016). PLS-SEM is a mature variance-based approach that has undergone severe methodological and theoretical examinations and has been the target of constructive scientific debates (Jörg Henseler, Hubona, & Ray, 2016). Hence, we estimate our model's parameters using SmartPLS version 3.2.7. (Ringle, Wende, & Becker, 2015). We propose a reflective measurement model (Mode A) for both the first and second-order constructs through which the manifest variables are affected by the latent variables. For this study, we used 500 replications within the bootstrapping procedure to obtain stable results and to interpret the structural model. As for sample size requirements, the included data exceeds all minimum requirements.

### 4.1 Outer model assessment

We assessed the reliability of the outer model for the construct and item level. Reliability at the construct level was performed by examining the composite reliability (CR) scores and established that their values were above the threshold of 0.70 (Nunnally & Bernstein). Furthermore, we assessed the obtained construct-to-item loadings. Hence, following (Fornell & Bookstein, 1982) we removed all manifest indicators with a loading less than 0.6<sup>38</sup> from our model. In total, we removed six indicators (i.e., no. 1, 2, 4, 10, 11, and 12) from the HIDE construct. Next, to reliability assessments, researchers should evaluate their measurement models by their convergent and discriminant validity (Campbell & Fiske, 1959; Fornell & Larcker, 1981; Hair Jr et al., 2016). We analyzed the average variance extracted (AVE), i.e., the average variance of measures accounted by the latent construct to assess convergent validity. The lowest AVE value is 0.550, and that still exceeds the lower limit of 0.50 (Fornell & Larcker, 1981).

Discriminant validity concerns the extent to which constructs are genuinely distinct from other constructs by empirical standards (Hair Jr et al., 2016). We assessed discriminant validity through different, but related tests. First, we checked for cross-loadings on other constructs (Farrell, 2010). Second, we investigated if the square root of the AVEs of all constructs is larger than the cross-correlation (Chin, 1998). All correlations among all constructs were below the threshold (0.70) (Fornell & Larcker, 1981). Third, and finally, we employed the heterotrait-monotrait (HTMT) ratio of correlations approach by Henseler, Ringle, & Sarstedt (Jörg Henseler, Ringle, & Sarstedt, 2015) that showed acceptable outcomes.

Based on these outcomes, we established adequate convergent and discriminant validity. Table 1 shows the primary outcomes of the reliability, convergent and discriminant validity assessments of our model.

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<sup>38</sup> An even more liberal threshold is a loading value of 0.4 for exploratory studies, see (Hulland, 1999).

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

	1	2	3
1. Collaborative networking assets	<b>0.751</b>		
2. IT flexibility	0.277	<b>0.781</b>	
3. Health information exchange	0.272	0.396	<b>0.742</b>
AVE	0.564	0.610	0.550
Composite reliability	0.721	0.757	0.879

#### 4.2 Hypotheses testing and uncovering heterogeneity issues

We estimated and validated the inner model, i.e., structural model and the relationship among its constructs to analyze the hypotheses. Outcomes reveal that FCI is significantly related to HIDE ( $\beta = .433$ ;  $t = 16.795$ ;  $p < .0001$ ). Moreover, the coefficient of determination ( $R^2$ ) explains 18.3% of the variance for HIDE ( $R^2 = .181$ ) with the control variable ‘hospital type’ showing a non-significant effect on HIDE ( $\beta = -.040$ ,  $t = 1.342$ ,  $p = .180$ ). These outcomes confirm our first hypothesis that hospitals’ FCI positively influences HIDE.

To test, if security measures have conditioning (i.e., moderating) impact on the relation between FCI and HIE; we performed a non-parametric multi-group analysis (PLS-MGA) (J Henseler, Ringle, & Sinkovics, 2009). Henceforth, we divided our sample into two separate groups (Hair Jr et al., 2016): group 1 ( $N = 482$ ) with a low level of security measures and group 2 ( $N = 501$ ) with a high degree of deployed security measures within the hospital. This subgroup approach is a widely used in regression-based approaches to test effects of categorical moderating variables (Baron & Kenny, 1986). We estimated the model for these two groups separately following Henseler et al. (2009). Group differences are significant (at the 5% probability of error level) within this procedure if the obtained  $p$ -value is  $\leq 0.05$  or  $\geq 0.95$  for the focal path, regression coefficients. Hence, analyses show a statistically significant difference ( $p = .971$ ) between group one and two. For group one (low-level of security) we see a significantly lower impact on HIDE by FCI ( $\beta = .346$ ,  $t = 8.460$ ,  $p < .001$ ). The model run for this particular group explains 11.7% of the variance for HIE. Group two (high-level of security), on the other hand, shows a significantly stronger effect, i.e., ( $\beta = .451$ ,  $t = 13.067$ ,  $p < .001$ ). More so, the model’s inner model for group two has an  $R^2 = .195$ . These obtained outcomes confirm our second hypothesis.

Next, we controlled for possible unobserved heterogeneity within these two subgroups by employing the finite mixture (FIMIX) PLS procedures (Sarstedt & Ringle, 2010). Therefore, we segmented the subgroups into two to five segments (s2 – s5) and ran separate analyses. Segmentation results do confirm that there indeed are factors that are currently not included in our analysis which might explain differences in coefficients of determination (up to  $R^2 = .335$  for the high-security group; a maximum  $R^2 = .135$  for the low-security group) across various hospital groups. Such a comprehensive FIMIX

analysis is beyond our current scope. Finally, to evaluate the overall predictive relevance of our model, we performed Stone–Geisser’s test using the blindfolding procedure in SmartPLS version 3.2.7. (Ringle et al., 2015). All case  $Q^2$  values for the single endogenous construct (for both communality and redundancy measures) were above the threshold value of zero, thereby indicating predictive relevance.

## 5 Discussion, conclusions, and limitations

From literature, we know that HIDE is a promising technology-driven approach to improve resource utilization, and quality of healthcare delivery (Vest et al., 2013). Outcomes of our analyses empirically support our claim and hypothesis that hospitals can enable HIDE through the use of FCIs. Furthermore, as substantiated by PLS-MGA analyses, hospitals’ FCIs can be exploited even more to facilitate the process of information sharing through the deployment of a range of security measures. With these outcomes, we make two substantial contributions to the literature. First, we contribute to the current knowledge base on HIDE by demonstrating the enabling effect of an FCI. Our results confirm past and recent claims made about the enabling role of flexible infrastructure configurations (Bhatt & Grover, 2005; Byrd & Turner, 2000; Kung et al., 2016). However, our study now shows that crucial role in the context of HIDE. Second, we extend recent conceptual literature (Benharref & Serhani, 2014; Sahama et al., 2013) by showing—using empirical data of 983 European hospitals—the conditioning role of deployed security measures in the process of exchanging health data.

These current insights should be interpreted with caution as Governmental agencies in various countries may regulate HIDE and thus also hospitals’ range of possibilities and opportunities to develop and deploy HIDE. Notwithstanding, from a practical relevance perspective, we believe that these results can help decision-makers in the process of efficiently allocating resources, and make purposeful IT investments to facilitate HIDE within the hospital enterprise.

Some limitations constrain this study that future research should seek to address. Our FIMIX results indicate that various homogeneous sub-groups can explain higher levels of  $R^2$  for HIDE. Future research could focus on a configurational approach (Meyer, Tsui, & Hinings, 1993) through which researchers can compare groups and (sub)segments in detail. A good starting point would be looking at, e.g., the degree of IT investments, organization size, and other potentially related digital capabilities (such as the capability to process information or telehealth). Hence, research could then refine our work so that we can advance our understanding of HIDE even further.

## References

- Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of management*, 17(1), 99-120.
- Baron, R. M., & Kenny, D. A. (1986). The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of personality and social psychology*, 51(6), 1173.
- Begole, J., Rosson, M. B., & Shaffer, C. A. (1999). Flexible collaboration transparency: supporting worker independence in replicated application-sharing systems. *ACM Transactions on Computer-Human Interaction (TOCHI)*, 6(2), 95-132.
- Benharref, A., & Serhani, M. A. (2014). Novel cloud and SOA-based framework for E-Health monitoring using wireless biosensors. *IEEE journal of biomedical and health informatics*, 18(1), 46-55.
- Bhatt, G. D., & Grover, V. (2005). Types of information technology capabilities and their role in competitive advantage: An empirical study. *Journal of Management Information Systems*, 22(2), 253-277.
- Blumenthal, D. (2010). Launching hitech. *New England Journal of Medicine*, 362(5), 382-385.
- Broadbent, M., Weill, P., & Neo, B.-S. (1999). Strategic context and patterns of IT infrastructure capability. *The Journal of Strategic Information Systems*, 8(2), 157-187.
- Byrd, T. A., & Turner, D. E. (2000). Measuring the flexibility of information technology infrastructure: Exploratory analysis of a construct. *Journal of Management Information Systems*, 17(1), 167-208.
- Caldeira, M. M., & Ward, J. M. (2003). Using resource-based theory to interpret the successful adoption and use of information systems and technology in manufacturing small and medium-sized enterprises. *European Journal of Information Systems*, 12(2), 127-141.
- Camarinha-Matos, L. M., Afsarmanesh, H., Galeano, N., & Molina, A. (2009). Collaborative networked organizations—Concepts and practice in manufacturing enterprises. *Computers & Industrial Engineering*, 57(1), 46-60.
- Campbell, D. T., & Fiske, D. W. (1959). Convergent and discriminant validation by the multitrait-multimethod matrix. *Psychological bulletin*, 56(2), 81.
- Carvalho, J. V., Rocha, Á., van de Wetering, R., & Abreu, A. (2017). A Maturity model for hospital information systems. *Journal of Business Research*.
- Chin, W. (1998). Issues and opinion on structural equation modeling. *Management Information Systems Quarterly*, 22(1), 7–16.
- DesRoches, C. M., Charles, D., Furukawa, M. F., Joshi, M. S., Kralovec, P., Mostashari, F., . . . Jha, A. K. (2013). Adoption of electronic health records grows rapidly, but fewer than half of US hospitals had at least a basic system in 2012. *Health affairs*, 10.1377/hlthaff.2013.0308.
- Dewett, T., & Jones, G. R. (2001). The role of information technology in the organization: a review, model, and assessment. *Journal of management*, 27(3), 313-346.
- Duncan, N. B. (1995). Capturing flexibility of information technology infrastructure: A study of resource characteristics and their measure. *Journal of Management Information Systems*, 37-57.
- Farrell, A. M. (2010). Insufficient discriminant validity: A comment on Bove, Pervan, Beatty, and Shiu (2009). *Journal of Business Research*, 63(3), 324-327.
- Fedorowicz, J., & Ray, A. W. (2004). Impact of HIPAA on the integrity of healthcare information. *International Journal of Healthcare Technology and Management*, 6(2), 142-157.
- Fornell, C., & Bookstein, F. (1982). Two structural equation models: LISREL and PLS applied to consumer exit-voice theory. *Journal of Marketing Research*, 19(4), 440–452.
- Fornell, C., & Larcker, D. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, 18(1), 39–50.

- Gnyawali, D. R., & Park, B.-J. R. (2011). Co-opetition between giants: Collaboration with competitors for technological innovation. *Research Policy*, 40(5), 650-663.
- Grefen, P. (2013). Networked business process management. *International Journal of IT/Business Alignment and Governance (IJITBAG)*, 4(2), 54-82.
- Hair Jr, J. F., Hult, G. T. M., Ringle, C., & Sarstedt, M. (2016). *A primer on partial least squares structural equation modeling (PLS-SEM)*: Sage Publications.
- Hendriks, H., Pippel, S., Van de Wetering, R., & Batenburg, R. (2013). Expectations and attitudes in eHealth: A survey among patients of Dutch private healthcare organizations. *International Journal of Healthcare Management*, 6(4), 263-268.
- Henseler, J., Hubona, G., & Ray, P. A. (2016). Using PLS path modeling in new technology research: updated guidelines. *Industrial Management & Data Systems*, 116(1), 2-20.
- Henseler, J., Ringle, C., & Sinkovics, R. (2009). The use of partial least squares path modeling in international marketing. *Advances in International Marketing*, 20(2009), 277-319.
- Henseler, J., Ringle, C. M., & Sarstedt, M. (2015). A new criterion for assessing discriminant validity in variance-based structural equation modeling. *Journal of the academy of marketing science*, 43(1), 115-135.
- Hersh, W. R., Totten, A. M., Eden, K. B., Devine, B., Gorman, P., Kassakian, S. Z., . . . McDonagh, M. S. (2015). Outcomes from health information exchange: systematic review and future research needs. *JMIR medical informatics*, 3(4).
- Hulland, J. (1999). Use of partial least squares (PLS) in strategic management research: a review of four recent studies. *Strategic Management Journal*, 20(2), 195-204.
- Kohli, R., & Tan, S. S.-L. (2016). Electronic health records: how can IS researchers contribute to transforming healthcare? *MIS Quarterly*, 40(3), 553-573.
- Kruse, C. S., Bolton, K., & Freriks, G. (2015). The effect of patient portals on quality outcomes and its implications to meaningful use: a systematic review. *Journal of medical Internet research*, 17(2).
- Kung, L., Wang, Y., & Kung, H.-J. (2016). Exploring Configurations for Business Value from Event-Driven Architecture in Healthcare.
- Lyytinen, K., Yoo, Y., & Boland Jr, R. J. (2016). Digital product innovation within four classes of innovation networks. *Information Systems Journal*, 26(1), 47-75.
- Meyer, A. D., Tsui, A. S., & Hinings, C. R. (1993). Configurational approaches to organizational analysis. *Academy of Management Journal*, 36(6), 1175-1195.
- Mikalef, P., Pateli, A., & van de Wetering, R. (2016). *IT flexibility and competitive performance: The mediating role of IT-enabled dynamic capabilities*. Paper presented at the 24th European Conference on Information Systems (ECIS).
- Mithas, S., Tafti, A., & Mitchell, W. (2013). How a Firm's Competitive Environment and Digital Strategic Posture Influence Digital Business Strategy. *MIS Quarterly*, 37(2).
- Nunnally, J., & Bernstein, I. Psychometric theory. 1994. *New York, NY: McGraw-Hill*.
- Österle, H., Fleisch, E., & Alt, R. (2012). *Business networking: Shaping enterprise relationships on the Internet*: Springer Science & Business Media.
- Patel, V., Abramson, E. L., Edwards, A., Malhotra, S., & Kaushal, R. (2011). Physicians' potential use and preferences related to health information exchange. *International journal of Medical Informatics*, 80(3), 171-180.
- Podsakoff, P. M., MacKenzie, S. B., Lee, J.-Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. *Journal of Applied Psychology*, 88(5), 879.
- Ringle, C. M., Wende, S., & Becker, J.-M. (2015). SmartPLS 3. *Boenningstedt: SmartPLS GmbH*, <http://www.smartpls.com>.
- Runyon, B., & Pessin, G. (2017). Hype Cycle for Real-Time Health System Technologies. *Gartner*, July 2017.

- Sahama, T., Simpson, L., & Lane, B. (2013). *Security and Privacy in eHealth: Is it possible?* Paper presented at the e-Health Networking, Applications & Services (Healthcom), 2013 IEEE 15th International Conference on.
- Sarstedt, M., & Ringle, C. (2010). Treating unobserved heterogeneity in PLS path modeling: a comparison of FIMIX-PLS with different data analysis strategies. *Journal of Applied Statistics*, 37(8), 1299–1318.
- Sauer, P. L., & Dick, A. (1993). Using moderator variables in structural equation models. *ACR North American Advances*.
- Tafti, A., Mithas, S., & Krishnan, M. S. (2013). The effect of information technology-enabled flexibility on formation and market value of alliances. *Management science*, 59(1), 207-225.
- Termeer, C. J., & Bruinsma, A. (2016). ICT-enabled boundary spanning arrangements in collaborative sustainability governance. *Current Opinion in Environmental Sustainability*, 18, 91-98.
- Van de Wetering, R., Mikalef, P., & Helms, R. (2017). Driving organizational sustainability-oriented innovation capabilities: a complex adaptive systems perspective. *Current Opinion in Environmental Sustainability*, 28, 71-79.
- Van de Wetering, R., Mikalef, P., & Pateli, A. (2017). *A strategic alignment model for IT flexibility and dynamic capabilities: toward an assessment tool*. In Proceedings of the 25th European Conference on Information Systems (ECIS), Guimarães, Portugal, June 5-10, 2017 (pp. 1468-1485).
- Vest, J. R., Champion, T. R., Kaushal, R., & Investigators, H. (2013). Challenges, alternatives, and paths to sustainability for health information exchange efforts. *Journal of Medical Systems*, 37(6), 9987.
- Wade, M., & Hulland, J. (2004). Review: The resource-based view and information systems research: Review, extension, and suggestions for future research. *MIS Quarterly*, 28(1), 107-142.
- Walker, J., Pan, E., Johnston, D., & Adler-Milstein, J. (2005). The value of health care information exchange and interoperability. *Health affairs*, 24, W5.
- Weill, P., & Ross, J. (2005). A matrixed approach to designing IT governance. *MIT Sloan Management Review*, 46(2), 26.
- Weill, P., & Vitale, M. (2002). What IT infrastructure capabilities are needed to implement e-business models? *MIS Quarterly*, 1(1), 17.

