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RESEARCH ARTICLE

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Synthesizing and Integrating Research on IT-Based Value Cocreation: A Meta-Analysis

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Abstract

IT value research has witnessed growing interest in the use of joint IT resources and capabilities following recent shifts in market competition from the firm to the network level. Despite research efforts in this domain, there remain substantial inconsistencies in the IT value cocreation literature regarding the effect of interorganizational IT on business value and the role of methodological and contextual factors. Drawing on the resource-based view and the relational view of the firm, we conducted a meta-analysis to synthesize and integrate the body of knowledge of IT-based value cocreation. Our analysis of 80 studies, encompassing 21,843 observations, highlights the value-generating effect of four interorganizational IT capabilities: IT-based relation-specific assets, IT-based knowledge sharing, IT-based complementary capabilities, and IT-based governance. Insights from our preliminary meta-analysis reveal that contradictory findings are driven by the conceptualization of IT variables as interorganizational IT resources. A further moderator meta-analysis explains divergent empirical findings in the literature. We find that the use of relational-level value and perceptual measures, use of single respondents, and the context of developing countries and supply chain and networked interdependencies result in larger estimates of business value. In contrast, the use of network-level, firm-level, and objective measures; use of matched-pair approaches; and the context of developed countries and pooled interdependencies result in smaller estimates. Overall, this paper provides clarity and structure to the current understanding of the research field by providing explanations for inconsistent findings as well as a foundation for future research and theory development.

Keywords: Value Cocreation, Relational View, IT Business Value, Interorganizational IT, Meta-Analysis.

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1 Introduction

With advancements in information technology (IT), research and practice continue to investigate the underlying mechanisms driving IT value creation. This is becoming an even greater challenge as interfirm cooperation increases among modern organizations. Interorganizational systems (IOS) such as eBusiness platforms, electronic data interchange (EDI), and supply chain systems can improve interfirm coordination and communication, increase innovation, and facilitate knowledge sharing (Chi & Holsapple, 2005; Constantinides, Henfridsson, & Parker, 2018). By combining such IT resources and developing interfirm capabilities, firms can cocreate superior benefits and synergies (Grover & Kohli, 2012). However, this can prove challenging due to the heterogeneous strategies, information systems, and

capabilities that must be integrated among firms (Rai et al., 2012). Furthermore, it is difficult to capture and manage the distribution of cocreated value (Kohli & Grover, 2008).

Research on IT value evaluates the economic impact of IT (Kohli & Grover, 2008). In an attempt to explain inconsistent findings in this research field, recent efforts have focused heavily on synthesizing IT value research through literature analysis, framework development (Kohli & Grover, 2008; Masli et al., 2011; Yassaee & Mettler, 2015), and meta-analyses (Kohli & Devaraj, 2003; Sabherwal & Jeyaraj, 2015). Research on IT-based value cocreation extends IT business value research to an interorganizational level of analysis, investigating how multiple firms can create value via joint IT resources and capabilities. This leads to complex research design decisions, such as choosing an appropriate level of analysis, considering new value-creation mechanisms, and selecting methodological approaches (Grover & Kohli, 2012). The importance of this research area has been addressed, for example, by recent publications on IT value (Masli et al., 2011; Sabherwal & Jeyaraj, 2015) and the 2012 MIS Quarterly special issue on cocreating IT value (Grover & Kohli, 2012). Despite significant efforts and important findings in the field of IT-based value cocreation, we observe two key inconsistencies in the current literature.

First, there are contradictions regarding the effect of interorganizational IT on business value. Although many studies reveal a positive relationship between interorganizational IT and business value, others suggest that value generation effects are nonexistent or even negative. For example, it is argued that inappropriate interorganizational IT investments may cause firms to become trapped in unprofitable relationships (Uotila, Keil, & Maula, 2017), which can hinder the adaptability of business processes (e.g., Gosain, Malhotra, & El Sawy, 2004) and lead to information overload and inefficient decisions (e.g., Dong, Fang, & Straub, 2017). This perspective is supported by studies that have failed to find a significant effect of interorganizational IT on business value (Choi & Ko, 2012; Saldanha et al., 2013; Truman, 2000). A potential source of this inconsistency is that scholars exercise varying definitions and conceptualizations of IT variables. For example, studies referring to "IS integration" often deal with different concepts, such as infrastructural (Saraf, Langdon, & Gosain, 2007), informational (Barua et al., 2004), or IT-enabled process integration (Rai et al., 2015). While the potential of interorganizational IT to create value is clear (Grover & Kohli, 2012), we aim to provide a more nuanced and theoretically founded understanding of the relationship between interorganizational IT and business value. This leads to our first research question:

RQ1: What is the effect of interorganizational IT on business value?

Second, studies on IT-based value cocreation employ different methodologies (e.g., type of measurement and level of analysis) and are conducted in different contexts (e.g., types of relationship). Meta-analyses of IT business value research (Kohli & Devaraj, 2003; Sabherwal & Jeyaraj, 2015) and other topics (Gerow et al., 2014; Heugens & Lander, 2009) indicate that methodological and contextual moderators can explain inconsistent findings in a research field. However, as most IT-based value cocreation studies are conducted in a single research context and employ a single methodology, there is a lack of studies examining the moderating effect of these factors. We define our second research question accordingly:

RQ2: How do the methodological and contextual attributes of the studies affect the relationship between interorganizational IT and business value?

The overarching aim of this study is to explain inconsistent findings on IT-based value cocreation by conducting a meta-analysis that synthesizes and integrates quantitative empirical findings. Building on the resource-based view (Barney, 1991; Teece, Pisano, & Shuen, 1997), the relational view (Dyer & Singh, 1998), and the related IT-based value cocreation framework developed by Grover and Kohli (2012), we distinguish between interorganizational IT capabilities and interorganizational IT resources. We develop a theoretical model proposing that four interorganizational IT capabilities have a direct effect on business value—(1) IT-based relation-specific assets, (2) IT-based knowledge sharing, (3) IT-based complementary capabilities, and (4) IT-based governance. Furthermore, we hypothesize that interorganizational IT capabilities mediate the relationship between interorganizational IT resources and business value. Through this model, we address inconsistencies regarding the impact of interorganizational IT on business value while using data that provide stronger evidence than a single primary study (Heugens & Lander, 2009; King & He, 2005). Furthermore, we conduct explorative analyses with no a priori expectation concerning the direction of the effect. Such data-driven research initiates future theory development (Hambrick, 2007) and is increasingly called for by IS researchers (Grover & Lyytinen, 2015).

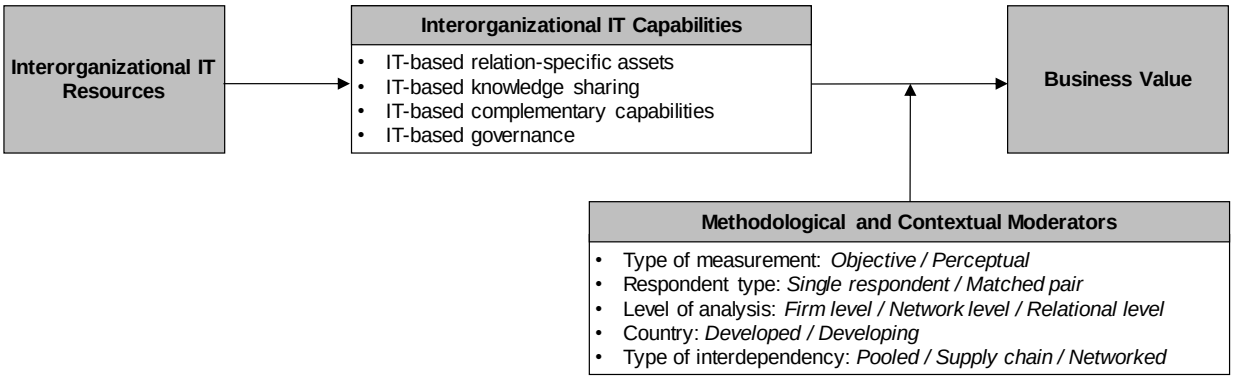

Figure 1. Research Model of IT-Based Value Cocreation

In particular, we investigate whether variation across studies depends on methodological and contextual factors (i.e., type of measurement, respondent type, level of analysis, country, and type of interdependency). We thereby analyze previously untested hypotheses and moderating effects that help to explain inconsistencies in research on IT-based value cocreation. Finally, we extend the review and meta-analysis of IT value literature of Kohli and Devaraj (2003) and Sabherwal and Jeyaraj (2015) to the interorganizational level in terms of sample, scope, and conceptualization.[1]

The remainder of this paper is structured as follows: First, we define the constructs and moderators identified in IT-based value cocreation research and derive the study's research model. We then describe the research design, including data collection, coding, and statistical analysis procedures. Next, we discuss the results in light of the current body of IT-based value cocreation literature, address limitations and further research opportunities, and close with a conclusive summary.

2 Research on IT-Based Value Cocreation

The concept of cocreation generally refers to collaboration between multiple stakeholders (Ranjan & Read, 2016). In the IS context, the term "cocreation of IT value" was introduced by Kohli and Grover (2008) as an extension for IT business value research in multifirm environments. IT-based value cocreation extends the level of analysis of IT business value research to interorganizational relationships, "examining how different companies with perhaps different IT can join together and create new value that either organization is unlikely to create on its own" (Grover & Kohli, 2012). Examples of this include the integration of digitalized supply chain processes with the help of supply chain collaborative systems (Hadaya & Cassivi, 2012; Jiang & Zhao, 2014), collaboration with third parties on IT-based platforms (Schreieck & Wiesche, 2017; Wang et al., 2017), and the development of new products in innovation networks using networked technologies (Prince, Barrett, & Oborn, 2014). In short, our focus lies on research that satisfies the following conditions: (1) IT-based variable or manifestation, (2) endogenous variable with an economic impact on organizational IT, and (3) at least the first condition lies at an interorganizational level of analysis.

Figure 1 summarizes the research model. In the following, we define the structural dimensions of the studies and develop hypotheses regarding the impact on business value.

2.1 The Relationship Between Interorganizational IT and Business Value

To consolidate ideas of how interorganizational IT leads to business value, we draw on the resource-based view (RBV) and the relational view of the firm (Dyer & Singh, 1998). The RBV maintains that the unique resources of a firm are the central source of competitive advantage (Barney, 1991; Teece et al., 1997), differentiating between resources and capabilities. Resources are "stocks of available factors that are owned or controlled by the firm" (Amit & Schoemaker, 1993, p. 35). As they are tradable and nonspecific to the firm, they can be transferred to another firm without significant loss of value (Drnevich & Croson, 2013; Wang et al., 2012). Transferring the RBV to the context of IT-based value cocreation, interorganizational IT resources refer to widely available and commodity-like physical IT infrastructure components, human IT skills, and IT-

[1] See Appendix A for further comparison between Sabherwal and Jeyaraj (2015) and the present study.

enabled intangibles that span organizational boundaries (Bharadwaj, 2000; Dyer & Singh, 1998; Nevo & Wade, 2010). Such resources—e.g., IOS such as extranets, supply chain management software, and EDI standards—can easily be purchased from the factor market and are not developed for any specific interfirm relationship (Hadaya & Cassivi, 2012). Thus, they are general enough to remain valuable when transferred to another interfirm relationship (Drnevich & Croson, 2013).

In contrast, capabilities refer to the firm's ability to "deploy resources, usually in combination, using organizational processes, to effect a desired end" (Amit & Schoemaker, 1993, p. 35). As they are nontradable and firm specific, they cannot be transferred to another firm without significant loss of value (Drnevich & Croson, 2013; Wang et al., 2012). Extended to IT-based value cocreation in interfirm relationships, interorganizational IT capabilities refer to the ability to deploy interorganizational IT resources in combination with complementary resources and capabilities to conduct interfirm business activities and enhance the value of non-IT resources (Bharadwaj, 2000; Drnevich & Croson, 2013; Rai et al., 2012). Interorganizational IT capabilities are developed specifically for the relationship and have no or significantly less value outside the interfirm relationship. Such capabilities include the analytical ability of IOS to leverage complementary capabilities (Lee & Wang, 2013) and effective governance via electronic cooperation (Choi & Ko, 2012).

The relational view extends the RBV, stating that by combining resources and capabilities in a unique way and creating idiosyncratic interfirm linkages, firms can create relational value—supernormal profits they could not attain on their own. Dyer and Singh (1998) assume four main sources of relational value: (1) interfirm relation-specific assets, (2) knowledge-sharing routines, (3) complementary resources and capabilities, and (4) effective governance. As each of these sources can be created, expanded, or enabled by interorganizational IT (Grover & Kohli, 2012) and thus enable idiosyncratic interfirm linkages, they represent interorganizational IT capabilities. Therefore, they cannot be transferred to another interfirm relationship without a significant loss of value.

We argue that interorganizational IT capabilities lead directly to business value (H1) because they are developed specifically for the interfirm relationship and cannot be transferred without a significant loss of value. They can then be characterized as sources of relational value as proposed by Dyer and Singh (1998) because they represent a unique combination of interorganizational resources and capabilities and foster idiosyncratic interfirm linkages (Rai et al., 2012).

Interorganizational IT resources, however, are not deemed sources of relational value because they are nonspecific resources that are widely available on the market. Because they can easily be transferred to any relationship, there is nothing idiosyncratic about these IT-related resources (Hadaya & Cassivi, 2012). While interorganizational IT resources must ultimately be integrated into interfirm business processes and activities and thus represent a necessary condition for developing interorganizational IT capabilities (Hadaya & Cassivi, 2012), these resources, per se, are available to all firms on the market. Hence, they are unlikely to explain variance in business value across interfirm relationships (Ray, Muhanna, & Barney, 2005; Wade & Hulland, 2004). Therefore, we propose that interorganizational IT resources only lead to business value indirectly (H2), i.e., that their effect is mediated by interorganizational IT capabilities.

In the following, we develop individual hypotheses for these conceptual relationships. The construct definitions are summarized in Table 1. A complete coding scheme for the IT variables can be found in Appendix D.

2.1.1 Interorganizational IT Capabilities

Drawing on the relational view (Dyer & Singh, 1998) and its application in IS research (Grover & Kohli, 2012), we identify four interorganizational IT capabilities. In the following, we analyze each of these interorganizational IT capabilities and how they contribute to business value.

IT-based relation-specific assets describe hardware, software, and network facilities that are specialized for the relationship and enable digital connections between firms (Grover & Kohli, 2012; Rai et al., 2015). Examples of these assets include integrated IT infrastructures (Rai, Patnayakuni, & Seth, 2006; Saraf et al., 2007) and digital platforms (Zhu et al., 2015). IT-based relation-specific assets correspond to the RBV's strategic assets (Amit & Schoemaker, 1993), i.e., the IT-related resources and capabilities that are scarce, specialized, and difficult to trade, imitate, and appropriate. As such, they are developed specifically for the relationship and foster idiosyncratic linkages between firms (Grover & Kohli, 2012; Saraf et al., 2007). IT-based relation-specific assets therefore lead to business value in several ways. First, as relation-specific resources and capabilities, they render further value-creating initiatives more economically viable (Hadaya & Cassivi, 2012; Saraf et al., 2007). Second, through the automation of interfirm business activities, IT-based relation-specific assets can reduce transaction costs and uncertainties by, for example, reducing paperwork and communication errors (Im & Rai, 2014; Rai et al., 2015).

Table 1. Interorganizational IT Capabilities and Resources Identified

Construct	Definition and measures
Interorganizational IT resources	*Definition:* Widely available and commodity-like physical IT infrastructure components, human IT skills, and IT-enabled intangibles that span organizational boundaries (Bharadwaj, 2000; Dyer & Singh, 1998; Nevo & Wade, 2010) *Illustrative measures:* IOS standards adoption (Zhao & Xia, 2014), IT for information partnering / transactions (Saldanha et al., 2013), Use of EDI (Vickery et al., 2003)
Interorganizational IT capabilities	*Definition:* The ability to deploy interorganizational IT resources in combination with complementary resources and capabilities to perform interfirm business activities and enhance the value of non-IT resources (Bharadwaj, 2000; Drnevich & Croson, 2013; Rai et al., 2012)
IT-based relation-specific assets	*Definition:* Hardware, software, and network facilities that are specialized to interfirm relationships and enable digital connections within them (Grover & Kohli, 2012) *Illustrative measures:* IS integration (Saraf et al., 2007), External IT linkages (Wei et al., 2013), Digital platform capability (Wang et al., 2017)
IT-based knowledge sharing	*Definition:* The ability to exchange information and knowledge within interfirm relationships based on IOS (Barua et al., 2004; Grover & Kohli, 2012) *Illustrative measures:* Online information capabilities (Barua et al., 2004), IOS visibility (Lee, Kim, & Kim, 2014), IOS-enabled knowledge sharing (Dong et al., 2017)
IT-based complementary capabilities	*Definition:* The ability to identify, exploit, and leverage complementary capabilities and resources by utilizing IT functionalities that synergistically complement each other (Grover & Kohli, 2012) *Illustrative measures:* IT use for exploitation / exploration (Subramani, 2004), IT capability profiles (Rai et al., 2012), Use of OSS (Im & Rai, 2014)
IT-based governance	*Definition:* The ability to coordinate, plan, control, and make decisions in interfirm relationships based on IOS (Grover & Kohli, 2012; Hadaya & Cassivi, 2012; Wang, Tai, & Grover, 2013) *Illustrative measures:* IT-enabled collaborative decision-making (Wong et al., 2015), IT-enabled planning and control (Wang et al., 2013), Analytic ability (Roberts & Grover, 2012)

Third, new business opportunities, such as access to new markets and improved customer satisfaction, can arise (Barua et al., 2004; Zhu & Kraemer, 2005). From this, we propose our first hypothesis:

H1a: IT-based relation-specific assets are positively related to business value.

IT-based knowledge sharing refers to the ability to exchange information and knowledge within interfirm relationships based on IOS, such as knowledge repositories or common databases (Grover & Kohli, 2012). Firms can develop advanced information-processing capabilities designed specifically to be embedded in interfirm processes to, for example, provide tactical information on demand (Barua et al., 2004). Accordingly, IT-based knowledge sharing leads to business value in two ways. First, the relational view argues that firms can cocreate value by developing the absorptive capacity to recognize, assimilate, and apply information to partner firms (Dyer & Singh, 1998). Interorganizational systems allow network partners to process large amounts of data and thus provide the infrastructural basis for absorptive capacity (Barua et al., 2004; Wong et al., 2015). Second, the reduction of technical barriers and seamless access to data initially leads to increased, more efficient, and more visible information flows among network partners (Barua et al., 2004; Roberts & Grover, 2012). Therefore, we propose the following hypothesis:

H1b: IT-based knowledge sharing is positively related to business value.

IT-enabled complementary capabilities describe the ability to identify, exploit, and leverage complementary capabilities and resources by utilizing IT functionalities that synergistically complement each other (Grover & Kohli, 2012). Firms have access to partner resources and capabilities that are not available on the market (Hadaya & Cassivi, 2012; Zhu & Kraemer, 2002). IT-enabled complementary resources and capabilities thus lead to business value through two mechanisms. First, they enable the exploitation of interfirm capabilities, i.e., improvements or refinement of interorganizational business activities and processes through a higher level of standardization and automation (Im & Rai, 2014; Subramani, 2004). Second, IT-enabled complementary capabilities facilitate the exploration of new interfirm capabilities by providing increased connectivity and communication (Hadaya & Cassivi, 2012; Zhu & Kraemer, 2002). For example, firms can complement

their IT capabilities by developing integrated customer knowledge platforms, leading to superior value outcomes (Sarker et al., 2012). Accordingly, we propose the following hypothesis:

H1c: IT-based complementary capabilities are positively related to business value.

IT-based governance in interfirm relationships refers to the ability to coordinate, plan, control, and make decisions in interfirm relationships based on IOS (Grover & Kohli, 2012; Hadaya & Cassivi, 2012; Wang et al., 2013). IT-based governance creates idiosyncratic firm linkages by providing incentives for partners in interfirm relationships to work together in order to leverage externality benefits (Grover & Kohli, 2012) and drives business value through two mechanisms. First, the relational view of the firm maintains that informal and self-enforcing governance mechanisms are more effective in driving value than formal arrangements are (Dyer & Singh, 1998). IT-based governance capabilities serve as safeguards, resulting in less opportunistic behavior and more intense collaborative management of relationships (Grover & Kohli, 2012; Lee et al., 2014; Wang et al., 2013). Second, due to more frequent interactions, IT-based governance leads to improved decision-making and planning processes in interfirm relationships (Wang et al., 2013). We therefore propose the following hypothesis:

H1d: IT-based governance is positively related to business value.

2.1.2 Interorganizational IT Resources

Several studies have investigated interorganizational IT resources in terms of investments (Sriram & Stump, 2004), use of commodity-like IOS (Saldanha et al., 2013), their adoption (Droge & Germain, 2000), or human- or knowledge-related resources (Ibrahim, Ribbers, & Bettonvil, 2012). In this paper, we argue that interorganizational IT resources indirectly lead to business value by developing advanced interorganizational IT capabilities. To do so, firms must first invest in joint technological and human- or knowledge-related resources (Hadaya & Cassivi, 2012). As such, IOS may be combined with complementary interorganizational resources and capabilities to create business value (Nevo & Wade, 2010; Rai et al., 2012). For instance, while investments in interorganizational technical resources like common data standards and integrated databases alone are insufficient for generating business value, they lay the technical foundation for the digitization of interfirm business processes and a higher quality of information exchange between network partners (Dong, Xu, & Zhu, 2009; Saraf et al., 2007). Furthermore, IT knowledge that is communicated with business partners by IT staff can be leveraged to improve interfirm processes and exploit new business opportunities (Ibrahim et al., 2012).

In contrast, we argue that interorganizational IT resources alone are insufficient for generating business value and that there is no direct effect between interorganizational IT resources and business value. As interfirm relationships increase organizational complexity with multiple partners, heterogeneous strategies, and contextual cultures, they become more difficult to organize and manage (Barringer & Harrison, 2000). Simply investing in or adopting IOS does not imply that partners in interfirm relationships have the appropriate systems in place to meet the specific challenges that arise from the network context (Saraf et al., 2007; Subramani, 2004). On the contrary, there may be effects that diminish the value of IOS. For instance, large investments into relation-specific standards and systems bear the risk of locking a firm into an unprofitable relationship (Saraf et al., 2007; Uotila et al., 2017), low-quality electronically shared information can lead to information overload and inefficient decisions (Dong et al., 2017; Malhotra, Gosain, & Sawy, 2007), and extensive control and monitoring through IOS can reduce trust between alliance partners (Nicolaou, Sedatole, & Lankton, 2011). Furthermore, large investments in inappropriate systems can cause rigidity traps and hinder the adaptability of business processes (Gosain et al., 2004; Saldanha et al., 2013). Even if organizations have invested in the appropriate interorganizational IT resources, these resources can be easily imitated by competitors because they are mobile in nature and widely available on the market. Therefore, they are unlikely to explain variance between competing firms cooperating in interfirm relationships (Hadaya & Cassivi, 2012; Mata, Fuerst, & Barney, 1995; Wade & Hulland, 2004).

In summary, we argue that interorganizational IT resources do not lead to business value unless they are leveraged in advanced interorganizational IT capabilities. Accordingly, they affect business value indirectly, leading to the following mediation hypothesis:

H2: Interorganizational IT capabilities mediate the relationship between interorganizational IT resources and business value.

2.2 Methodological and Contextual Moderators

To answer our second research question, we analyze how methodological and contextual factors might affect the study's results. In terms of methodology, measurement is a major issue in IT value research and can explain the divergent results (Chan, 2000; Sabherwal & Jeyaraj, 2015). Furthermore, contextual variables are likely to influence the effect of IT on business value in interorganizational settings (Grover &

Saeed, 2007; Zhu & Kraemer, 2005). By considering methodological and contextual variables as moderators for our meta-analyses, we examine possible explanations for variation across studies (Hunter & Schmidt, 2004), testing previously unassessed relationships (Eden, 2002). Definitions of the moderator variables are offered in Table 2.

We examine two methodological moderators. First, we analyze the type of respondents: data can be collected from a single informant or by matching responses from two individuals in different firms but with the same relationship. Because single informants may not have adequate knowledge about the relationship as a whole and can over- or underestimate variables—especially in asymmetric relationships—matched-pair surveys tend to be more reliable (John & Reve, 1982; Ryoo & Kim, 2015) and can also reduce common method bias (Tallon & Pinsonneault, 2011). However, matched pairs can also compromise the anonymity of the survey (Kearns & Sabherwal, 2007) and prove especially difficult to conduct across firms (Duffy, 2008), which can lead to measurement errors (Gerow et al., 2014).

Second, we distinguish two types of measurement: objective and perceptual (Chau, Kuan, & Liang, 2007). Although objective measures tend to be more reliable, perceptual measures are better suited to the study's context and variables of interest (Chau et al., 2007; Sabherwal & Jeyaraj, 2015). Because of methodological challenges and a lack of information on the companies surveyed, it can become even more difficult to find or develop appropriate measures at an interorganizational level of analysis (Straub, Rai, & Klein, 2004).

Table 2. Methodological and Contextual Moderators Identified

Moderator	Definition
Respondent type	
Single respondent	A single respondent answered the questionnaire
Matched pair	More than one respondent answered the questionnaire
Type of measurement	
Objective	Data were collected from organizational records and official documents
Perceptual	Data were collected from perceptions of the respective evaluators
Level of analysis	
Firm-level value	*Definition:* Outcomes of an individual organization *Illustrative measures:* Return on assets (Rai et al., 2015), Competitive performance (Subramani, 2004) *Example questionnaire item: "*Over the past 3 years, our financial performance has exceeded our competitors"
Network-level value	*Definition:* Outcomes of an entire set of networked organizations *Illustrative measures:* Share of wallet (Rai et al., 2012), Joint performance (Dong et al., 2017) *Example questionnaire item:* "We have generated a considerable amount of profits together" (matched pair)
Relational-level value	*Definition:* Impact of a network on outcomes of an individual organization *Illustrative measures:* Relation-specific performance (Klein & Rai, 2009), eBusiness value (Zhu, Kraemer, Xu, & Dedrick, 2004) *Example questionnaire item:* "Our organization has realized the following performance outcomes as a result of our interactions with this business partner…"
Country	
Developed	The study was conducted in a developed country (International Monetary Fund, 2015, pp. 150-153)
Developing	The study was conducted in a developing country (International Monetary Fund, 2015)
Type of interdependency	
Pooled	The study's unit of analysis is a relationship in which "multiple firms use and share common resources but are otherwise independent" (Kumar & van Dissel, 1996, p. 283)
Supply chain	The study's unit of analysis is a relationship in which "the output from one unit becomes input to another unit" (Kumar & van Dissel, 1996)
Networked	The study's unit of analysis is a relationship in which firms collaborate in mutual exchange and interactively in networked interdependencies (Kumar & van Dissel, 1996)

Next, we examine three contextual moderators, beginning with the level of analysis according to the business value dimensions identified by Straub et al. (2004) and Provan et al. (2007). First, firm-level value includes organizational outcomes analyzed independently of the interfirm relationship, such as the effect of IT-enabled interfirm process integration on the return on assets of a focal firm (Rai et al. 2015). Second, network-level value refers to outcomes that are jointly realized by an entire set of organizations. For example, performance can be measured independently by a client and a vendor and then be calculated with a symmetry index to the performance of a client-vendor dyad (Straub et al., 2004). Third, business value can be analyzed at the relational level, where the effects of relationships on the outcomes of individual organizations are examined (Provan et al., 2007). This allows one to measure, for example, a single firm's performance improvements that result from collaboration with a business partner (Klein & Rai, 2009). There are three prevalent arguments, which differ in their views of interorganizational IT's effectiveness across their respective business value dimensions. The first maintains that the impact of IT should be greater at the specific domain of interest where immediate effects are expected (Ray et al., 2005). In the context of value cocreation, this would be the network and relational levels, as interorganizational IT first affects collective outcomes, which, in turn, lead to value for the individual firms (Chang & Shaw, 2009). Firm-level value is therefore subject to greater influence from other factors, possibly weakening the impact of interorganizational IT. The second argument is that interorganizational IT capabilities may affect the business value of organizations in a network at varying magnitudes and value may be shared unequally among organizations. For example, within the supply chain, electronic information transfer provides significantly greater benefits to upstream firms in order to counteract the "bullwhip effect" (Lee, Padmanabhan, & Whang, 1997). As researchers often focus on certain network layers, such as the supply side or the demand side (Uotila et al., 2017), firm- and relational-level value may be perceived to differ substantially from network-level outcomes (Straub et al., 2004). The third argument is that measures at the network level are often calculated as aggregated outcomes of independently measured firm-level outcomes (Straub et al., 2004). As such, network-level measures may be less biased than firm- or relational-level outcomes (Dong et al., 2017), resulting in smaller estimates of business value.

Second, we investigate the role of the economic region in terms of developing and developed countries. It is argued that firms in developing countries have less access to the resources, skilled labor, and technological infrastructure required to develop reliable IT capabilities (Shih, Kraemer, & Dedrick, 2008). In contrast, regulatory support and minimal competitive pressure (Zhu & Kraemer, 2005), as well as the high potential of IT capabilities for improvement (Piatkowski, 2006), might foster IT-based value cocreation in developing countries. Previous studies on IT value have revealed contradictory findings regarding the role of the economic region (Patrakosol & Lee, 2009; Sabherwal & Jeyaraj, 2015), identifying regional context as a potential source of inconsistencies in IT value findings.

Third, we analyze the three types of interdependency among firms as a contextual variable based on Kumar and van Dissel (1996). In pooled interdependencies, multiple firms use and share common resources, while supply chain interdependencies feed the output from one firm as input for another firm (e.g., buyer-supplier relationships). The third type is a networked interdependency, where firms collaborate in mutual exchange and interaction, such as in collaborative alliances. Researchers argue that the impact of certain IOS differs among these relationship types (Chi & Holsapple, 2005; Kumar & van Dissel, 1996), which can cause variations in the magnitude of the relationship between interorganizational IT and business value.

Considering limitations in existing research on theoretical foundations regarding the role of these moderators, including conflicting results, we analyze the moderation effects in an explorative manner and leave theoretical explanation for future research. Accordingly, we propose a nondirectional hypothesis:

H3: Methodological and contextual variables moderate the relationship between interorganizational IT capabilities and business value.

3 Meta-Analysis

This study employs a meta-analysis to test the main effect of interorganizational IT on different business value dimensions. A subset analysis test is then used to assess the moderating effects of the methodological and contextual attributes.

Meta-analysis is a statistical method that systematically aggregates the quantitative results of primary studies and, in doing so, allows for higher-level statistical analysis of the measures of interest (King & He, 2005; R. Rosenthal, 1991). This methodology is particularly suitable for this analysis because it not only enables us to integrate findings of previous studies in a rigorous and quantitative fashion, but it also allows us to analyze the effects of context-dependent factors. This helps us to understand inconsistencies among studies and consolidate

contradictory findings on the IT-business value relationship.

The research design involved three basic steps. First, we collected quantitative papers with interorganizational settings that address the relationship between IT and value variables. In the second step, we used these papers to extract a database of studies and calculated a quantitative measure ("effect size") for IT-business value relationships. The studies were then coded for selected variables of interest, i.e., the type of interorganizational IT, business value dimensions, and methodological and contextual factors. This database constitutes the basis for the following statistical analysis, which aims to identify and analyze the moderators.

3.1 Data Collection Procedure

The meta-analysis began with the identification of studies reporting sufficient data on the association between IT and business value in interfirm relationships. Our procedure for data collection included searches through scientific databases in addition to gathering studies from prior meta-analyses, which is consistent with the recommendations of Hunter and Schmidt (Hunter & Schmidt, 2004) and other IS meta-studies (Gerow et al., 2014; Kohli & Devaraj, 2003; Sabherwal & Jeyaraj, 2015; Wu & Lederer, 2009).

Publications were collected until October 2017. We began our search for such studies in Business Source Complete (EBSCOhost), ScienceDirect (ELSEVIER), ProQuest Dissertations & Theses database, and the Association for Information Systems Electronic Library (AISeL). The papers included in the analysis were identified using keywords such as "value cocreation," "relational value," and "IT value" in conjunction with terms such as "interorganizational," "interfirm," "collaborative network," "corporate network," "cluster," and "alliance." We used prior meta-analyses on IT value as an additional source of studies, screening those used in Kohli and Devaraj (2003), Sabherwal et al. (2006), and Sabherwal and Jeyaraj (2015) to include only studies investigating interfirm relationships. Meta-analyses may be biased by the file drawer effect (Robert Rosenthal, 1979), which refers to the tendency of journals to preferentially publish significant results, thereby biasing the results of exclusive, journal-centric analyses (Dickersin, 1990). To counteract this effect, we explicitly included conference publications and dissertations in our search. Furthermore, we searched for unpublished articles by emailing the authors of the studies included in our sample to request any additional correlation tables (we emailed 105 authors). This resulted in two additional papers for our initial sample.

We applied four inclusion criteria for our final sample, which are summarized in Table 3. First, we investigated studies discussing relationships between an IT-based variable or manifestation and business value. We applied the conditions of IT value research proposed by Kohli and Grover (2008). For this criterion, we followed a broad conceptualization of IT for the IT variable; besides IT-related resources such as hardware and software, we also included studies operationalizing IT management and organizational concepts, such as IT capabilities. Regarding business value, we limited our literature pool to studies utilizing value measures with an economic impact. In addition to tangible performance measures, we also considered intangible business value dimensions, such as supply chain agility (Lee & Wang, 2013) and relationship quality (Im & Rai, 2014). Nine studies were excluded based on this criterion.

Table 3. Inclusion Criteria

Criterion	No. of excluded studies	Examples of excluded studies
1. The study must report relationships between an IT variable and business value.	9	(Li, Ye, & Sheu, 2014; Lorenzo Ochoa, Claes, Koryak, & Diaz, 2017; Preston, Chen, Swink, & Meade, 2017)
2. The study's unit of analysis must be at the interorganizational level.	33	(Banker, Bardhan, Chang, & Lin, 2006; S. Bharadwaj, Bharadwaj, & Bendoly, 2007; Bhatt & Grover, 2005)
3. The study must report sample sizes as well as sufficient information to derive a correlation between IT and business value.	12	(S. Dong et al., 2009; Kim, Cavusgil, & Calantone, 2006; Premkumar, Ramamurthy, & Saunders, 2005)
4. The study must provide an independent dataset.	13	(Im, 2006; Patnayakuni, 2001; Saraf, 2003)

Second, the study's unit of analysis had to be at the interorganizational level to be classified as IT-based value cocreation research. We also included studies utilizing firm-level value measures. Because it is difficult to collect data for network-level outcomes (Straub et al., 2004), especially with objective measures, studies on IT-based value cocreation also employ firm-level measures for outcome variables. Collective outcomes generated through interorganizational IT are eventually absorbed by network members to realize firm-level value (Chang & Shaw, 2009; Lavie, 2006). Therefore, such research can still be classified as IT-based value cocreation. However, as our study's focus and the conceptualization of the IT variables required analysis at the interorganizational level, 33 studies that concentrated on firm-level analysis were ultimately excluded from our sample.

Third, we required included studies to report sample sizes as well as effect size estimates (Hunter & Schmidt, 2004; Rosenthal, 1991). We first checked for zero-order correlations. If a study did not directly report this information, we looked for test statistics (e.g., covariances, β values, regression coefficients) that could be converted into correlations (see Appendix E in Wu & Lederer, 2009). If this information was also unavailable, we contacted the author via email and asked whether he or she would be willing to send us a correlation table. If attempts to obtain effect size estimates from both the paper and the author were unsuccessful, the study was excluded from our sample; 12 studies were excluded based on this criterion.

Fourth, we required that the studies included provide an independent dataset. Accordingly, we carefully compared author information as well as descriptive and statistical data (Wu & Lederer, 2009). For datasets that were reported more than once (e.g., dissertations and journal articles), we selected the publication stemming from the higher outlet for our dataset. However, if the publications with the same dataset differed in terms of variables that would be important for our later analysis, the publications were treated as if they came from the same study (Im & Rai, 2008, 2014). When publications reported several studies based on independent datasets, they were treated as different studies. When a study included several IT or business value variables, it was added to the database as separate correlations that stem from different publications but the same dataset (Hunter & Schmidt, 2004). In total, 13 studies were excluded based on this criterion.

The final sample comprises 79 publications, including 80 studies (i.e., datasets—some papers include multiple studies) and 205 IT-business value correlations, all of which were published between 1999 and 2017. Of the publications, 66 are journal articles, 10 are conference proceedings, 2 are dissertations, and 1 is unpublished. Together, they represent a total of 21,843 different observations. The full list of studies can be found in Appendix B.

3.2 Coding of Studies and Measurement of Variables

The coding procedure began with gathering data for the IT value relationship. To measure the effect size of this relationship, we coded for the correlation between IT and business value. The coding procedure for each study also included capturing information for the following variables.

Interorganizational IT: We developed coding criteria to determine whether an IT variable was measured as a specific interorganizational IT capability (i.e., an IT-based relation-specific asset, IT-based knowledge sharing, an IT-based complementary capability, or IT-based governance) or an interorganizational IT resource. The coding scheme is shown in Appendix D and examples of classifying an interorganizational IT resource and an interorganizational IT capability are provided in Appendix E. The IT variable of each correlation was categorized according to this coding scheme.

Methodological and contextual moderators: The moderator variables were coded according to the definitions provided in Table 2. A correlation was coded for business value as "firm level / network level / relational level" according to the outcome variable(s) of each study. We draw on the classifications of Straub et al. (2004) and Provan et al. (2007): If the variable assessed outcomes of an individual organization, independently of the relationship (e.g., return on assets), it was coded as firm-level value. Furthermore, if the variable measured outcomes of multiple organizations (e.g., joint performance in a matched-pair survey), it was coded as network-level value. Lastly, if the business value variable captured the impact of a network or relationship on the outcomes of an individual organization (e.g., relationship-specific performance), it was coded as having relational-level value. The variable "matched pair / single informant" captures whether the data for IT and/or business value was collected from a single respondent or more than one. We coded information regarding the measurement of the business variables with the labels "objective / perceptual," indicating the data source as either objective measures obtained from organizational records and official documents (e.g., return on assets) or perceptions of the respective evaluators (e.g., perceived performance) (Cameron & Whetton, 1983; Schryen, 2013). The variable "pooled / supply chain / networked" represents the interorganizational business relationship under study, following Kumar and van Dissel's (1996) classification. The "developing country / developed country" variable was coded

according to the sample of each study, following the classification in the World Economic Outlook (Tables B and E in the Appendix) of the International Monetary Fund (2015). The categories for the moderators were not mutually exclusive. For instance, a study could be conducted in multiple countries, including both developing and developed countries (Zhao & Xia, 2014). These studies were excluded from the respective moderator analysis.

3.3 Data Analysis

This study relies on Hunter and Schmidt's (2004) method of meta-analysis, which finds broad application in other management and IS research (Fang et al., 2015; Gerow et al., 2014; Heugens & Lander, 2009; Wu & Lu, 2013). We chose this approach over other estimators for two reasons. First, in contrast to methods that rely on a fixed-effects estimator, Hunter and Schmidt's (2004) approach provides a random-effects estimator. Fixed effects estimations assume that all observed correlations are randomly drawn from the same population. However, this assumption is often violated. Random effects models provide a more conservative estimator and allow for the possibility that population parameters vary among the studies. The latter better fits the heterogeneity of sample characteristics that we observe in our sample of studies, e.g., in terms of the distribution of countries or industries. Second, study artifacts such as sample sizes and measurement errors can systematically bias the estimations. The Hunter and Schmidt (2004) approach provides a method to correct reported correlations and thus to aggregate and compare true population correlations across studies.

Based on the initial coding of all available study correlations, grouping procedures were started for both the direct hypotheses and each mediation hypothesis. In a first step, all study correlations were either allocated to one of the four interorganizational IT capabilities (H1) or identified as an IT resource (H2) by the independent variable. In a second step, all study correlations were grouped according to their moderation variables (H3). The subgroups still revealed correlations stemming from the same study. To avoid bias due to dependencies between our correlations, composite correlations and composite reliabilities were calculated for each study reporting multiple correlations within one group (Hunter & Schmidt, 2004).

To calculate true population correlations (rho), we accounted for measurement reliabilities of each study in these subgroups. Different reliabilities in independent and dependent variables are important study artifacts that can attenuate reported correlations. Because reliability scores in study reports offered partially incomplete information, we calculated an attenuation factor based on artifact distribution. Correlations and subsequent variance analyses were corrected accordingly (Hunter & Schmidt, 2004). To evaluate the hypotheses, we computed mean rho values, credibility intervals, and confidence intervals. Mean rho values are point estimators of the average corrected correlation in the population, while credibility intervals "refer to the distribution of parameter values" (Hunter & Schmidt 2004, p. 205) and thus provide information on the homogeneity of true correlations in the population. Overlapping credibility intervals between two distributions suggest that some rho values have similar strengths. The confidence intervals, in turn, "refer to estimates of a single value—the value of rho" (Hunter & Schmidt 2004, p. 205) and are based on the standard error of the estimated mean population correlation. Confidence intervals that do not overlap indicate that the mean correlations are likely different.

Our approach for meta-moderation analysis is based on analysis of subsets. In line with Hunter and Schmidt's (2004) recommendation for predicted moderators, we evaluate the moderation hypotheses primarily by comparing confidence intervals of the estimated mean correlations.

3.4 Results

The results of the estimation for the direct relationship can be found in Table 4. For example, we find that IT-based relation-specific assets have an estimated mean rho of 0.427 and a credibility interval with a lower bound of 0.187 and upper bound of 0.667. The estimated mean rho displays a positive estimated effect size for the relation. Furthermore, the credibility interval does not include zero, indicating that all correlations of the respective population are positive and thus offering support for H1a. As all capabilities have a positive estimated mean rho with credibility intervals different from zero, there is also support for H1a-d. IT-based governance has the highest mean rho among all capabilities. In comparison to IT-based relation-specific assets and complementary capabilities, the confidence interval around this point estimator suggests a specific relation with IT business value.

For the effect of interorganizational IT resources on interorganizational IT capabilities, we found both positive credibility intervals that are different from zero, thus offering support for H2. Together with the results of H1a-H1d, this indicates support for the indirect effect of interorganizational IT resources. We also analyzed the direct effect of interorganizational IT resources on business value. While the estimated mean rho is positive and the confidence interval suggests that the mean is different from zero, the credibility interval tells a more nuanced story.

Table 4. Results of the Meta-Analysis for Hypotheses 1a-d and 2

Predictor	$\hat{\rho}$	*k*	*N*	$Var._{\rho}$	SD_r	Range *r*	$CV_{80\%}$	$CI_{95\%}$	PVA	Failsafe *N*
Hypotheses 1a-1d: Interorganizational IT capabilities → Business value										
IT-based relation-specific assets	.427	43	8,589	.035	.165	.095, .730	.187, .667	.378, .476	.188	135
IT-based knowledge sharing	.436	11	2,595	.020	.132	.219, .597	.254, .618	.358, .514	.238	35
IT-based complementary capabilities	.376	19	6,167	.085	.233	-.039, .740	.002, .749	.271, .481	.068	55
IT-based governance	.552	22	3,577	.024	.146	.081, .657	.354, .751	.491, .613	.247	83
Hypothesis 2: Interorganizational IT resources → Interorganizational IT capabilities										
Interorganizational IT resources	.344	6	768	.054	.209	-.365, .502	.046, .641	.177, .511	.188	16
Interorganizational IT resources → Business value										
Interorganizational IT resources	.148	22	8,624	.048	.149	-.080, .550	-.132, .429	.086, .210	.128	38

Notes: $\hat{\rho}$ = sample size weighted mean of corrected population correlations; *k* = number of correlations; *N* = total sample size; $Var._{\rho}$ = variance of true score correlation ρ; SD_r = standard deviation of sample size corrected correlation r; Range *r* = range of uncorrected correlations; $CV_{80\%}$ = 80% credibility interval around true score correlation ρ; $CI_{95\%}$ = 95% confidence interval around true score correlation ρ; PVA = percentage of variance accounted for by sampling and measurement error; Orwin's fail-safe *N* = computed with a criterion correlation of 0.2.

The range of correlations at the population level included both positive and negative values and held the lowest mean rho compared to all four capabilities. Moreover, we found non-overlapping confidence intervals of the direct effect of interorganizational IT resources on business value with all four capabilities. In order to delve deeper into the relationship between interorganizational IT resources, capabilities, and business value, we estimated a structural model using a two-stage meta-analytic structural equation modeling approach and conducted a formal mediation analysis (see Appendix F for the detailed results). The results show a significant indirect effect between interorganizational IT resources over capabilities on business value.[2] In sum, we interpret the result as evidence for the indirect effect of interorganizational IT resources through interorganizational IT capabilities on business value. When interpreting the results in regard to H2, the comparably low *k* value (i.e., the number of studies used) should be taken into account, as six independent study correlations lie below the recommended threshold for ensuring generalizability (Switzer, Paese, & Drasgow, 1992).

We also aimed to analyze correlations among the interorganizational IT capabilities (see Appendix C). Our sample reveals correlations with overlapping credibility and confidence intervals among all variables. However, the results should be interpreted with caution due to the low number of studies used (with *k* values between 2 and 9).

All four capabilities and IT resources reveal a low PVA (i.e., the variance that can be attributed to sampling and measurement error). Generally, this indicates that there is variance left at the population level that can be explained by moderators.

Before conducting the moderator analysis with the subgroups, we directly tested for the potential of moderators using Cochran's *Q* test for homogeneity (Hunter & Schmidt, 2004). The path between interorganizational IT capabilities and business value revealed the presence of considerable heterogeneity in the distributions of the correlations ($Q = 571.413$, $df = 64$, $p < 0.01$).

[2] We would like to thank two anonymous reviewers who pointed us in the direction of meta-analytic structural equation modeling. Adding this approach allowed us to delve deeper into the mechanisms of the moderator and increased the robustness of our findings.

Table 5. Results of the Moderator Meta-Analysis for Hypothesis 3

Predictor	$\hat{\rho}$	*k*	*N*	$Var._{\rho}$	SD_r	Range *r*	$CV_{80\%}$	$CI_{95\%}$	PVA	Failsafe *N*
Respondent type										
Single respondent	.453	53	11,342	.031	.156	.001, .735	.230, .677	.411, .495	.201	173
Matched pair	.171	12	2,857	.035	.162	.012, .526	-.067, .410	.080, .263	.162	22
Type of measurement										
Objective	.103	5	2,354	.027	.140	.012, .582	-.109, .315	-.020, .225	.111	8
Perceptual	.455	60	11,845	.027	.149	.001, .735	.245, .665	.417, .493	.232	197
Business value dimensions										
Network-level value	.269	19	4,538	.047	.193	.012, .590	-.008, .547	.183, .356	.107	45
Relational-level value	.474	37	7,510	.025	.145	.120, .735	.271, .677	.428, .521	.241	125
Firm-level value	.345	17	3,818	.026	.138	.001, .515	.137, .552	.279, .410	.251	46
Country										
Developed country	.369	50	10,642	.045	.183	.001, .735	.096, .642	.318, .420	.143	142
Developing country	.573	12	2,040	.003	.088	.270, .582	.501, .645	.523, .623	.743	46
Type of interdependency										
Pooled	.168	8	2,939	.041	.169	.012, .570	-.091, .427	.051, .285	.098	15
Supply chain	.434	46	9,284	.028	.151	.001, .735	.220, .649	.391, .478	.222	146
Networked	.560	11	1,976	.014	.121	.233, .646	.406, .714	.488, .632	.380	42

Notes: $\hat{\rho}$ = sample size weighted mean of corrected population correlations; *k* = number of correlations; *N* = total sample size; $Var._{\rho}$ = variance of true score correlation ρ; SD_r = standard deviation of sample size corrected correlation r; Range *r* = range of uncorrected correlations; $CV_{80\%}$ = 80% credibility interval around true score correlation ρ; $CI_{95\%}$ = 95% confidence interval around true score correlation ρ; PVA = percentage of variance accounted for by sampling and measurement error; Orwin's fail-safe *N* = computed with a criterion correlation of 0.2.

The results of the moderator analysis are presented in Table 5. For example, studies with a single informant approach have an estimated mean rho of 0.453, while studies that follow a matched pair design have an estimated mean rho of 0.171. The confidence intervals of the subgroups do not overlap, with an upper bound of 0.263 for matched pair design and a lower bound of 0.411 for the single respondent design. These non-overlapping confidence intervals indicate that the estimated mean rhos are different. The results also suggest that studies with perceptual measures have a higher mean rho than those with objective measures.

For the level of analysis, relational-level value was revealed to have the highest mean rho compared to network-level value and firm-level value. The highest correlation for the relational level of analysis is also underpinned by a confidence interval that does not overlap with those of the other dimensions. Network-level and firm-level business value dimensions reveal similar mean rho values and overlapping confidence intervals.

For contextual variables, we found that developed countries have lower estimated mean rhos than developing countries. The higher mean rho for developing countries is supported by non-overlapping

confidence intervals. For the interdependency type, we see the highest mean rho for supply chain, followed by networked and pooled types. The order of the effect sizes (i.e., the estimated mean rho) is supported by non-overlapping confidence intervals.

To check the robustness of these findings, we computed fail-safe *N* statistics (Orwin, 1983), which display the number of nonsignificant publications that would be required to reduce the estimated effect size to a trivial level. The fail-safe *N* exceeds the number of studies used in each estimation, indicating that unpublished and nonsignificant studies were not a threat for our analysis. Moreover, our estimators for the population correlations were weighted by each study's sample size. Population-level estimations can thus be biased by single studies with comparably high sample sizes and unique features in their study designs. In our sample correlations, we found five studies with sample sizes above 1,000. A reestimation without these studies did not change the interpretation of the results, including positive mean rho values, order of mean rho values, and credibility intervals in terms of inclusion/exclusion of 0.

4 Discussion

4.1 Findings, Implications, and Future Research

This study aimed to explain inconsistent findings regarding IT-based value cocreation through a systematic meta-analysis synthesizing and integrating quantitative results of relevant studies in this research field. Accordingly, we set out to resolve inconsistencies concerning the relationship between interorganizational IT and business value, not only in terms of its effect but also regarding possible methodological and contextual attributes. In the following, we outline how our meta-analytical findings address these inconsistencies and lead to a better understanding of the research field as a whole.

4.1.1 The Effect of Interorganizational IT on Business Value

Our first research questions aimed to determine the effect of interorganizational IT on business value. Based on the RBV and the relational view, we differentiated among interorganizational IT resources and four interorganizational IT capabilities and then analyzed their effects on business value. In the following, we outline our key findings, implications, and future research directions, which are also summarized in Table 6.

Our first finding is that IT-based relation-specific assets, knowledge sharing, complementary capabilities, and governance as interorganizational IT capabilities have a positive correlation with business value across all studies. While some studies have indicated that interorganizational IT may also negatively affect business value (Gosain et al., 2004; Saldanha et al., 2013), we observed no contradiction in the relationship between interorganizational IT and business value when the IT variable is conceptualized as interorganizational IT capability. Accordingly, the results provide strong theoretical support for the relational view (Dyer & Singh, 1998) and its application in IS research (Grover & Kohli, 2012). The findings reveal that the effect of interorganizational IT on business value stems from creating idiosyncratic linkages between firms by deploying interorganizational IT resources in combination with complementary resources and capabilities. Value can then be cocreated when IT meets the specific challenges arising from the network context, which can be achieved by developing unique interorganizational IT capabilities (Saraf et al., 2007; Subramani, 2004).

Second, we find that interorganizational IT capabilities fully mediate the relationship between interorganizational IT resources and business value. While some scholars in IT-based value cocreation research have already differentiated between resources and capabilities (Hadaya & Cassivi, 2012; Ibrahim et al., 2012), most fail to specify whether their focus lies on interorganizational resources or capabilities. Our findings indicate that the differentiation between interorganizational IT resources and capabilities is imperative because their effect on business value is fully mediated by interorganizational IT capabilities. Accordingly, contradictions in the IT-based value cocreation literature may stem from conceptualizing IT variables as resources. While our mediation analysis indicates that interorganizational IT resources are a necessary condition for cocreating value (Hadaya & Cassivi, 2012), they alone are insufficient, as the simple availability of IOS could also result in negative impacts such as lock-in effects (Saraf et al., 2007; Uotila et al., 2017). Furthermore, as interorganizational IT resources are widely available on the market and can be transferred to any interfirm relationship without significant loss of value, they are unlikely to explain variance across competing firms cooperating in interfirm relationships (Ray et al., 2005; Wade & Hulland, 2004). Accordingly, the value of interorganizational IT resources can only be realized by developing interorganizational IT capabilities. These results differ from those of Sabherwal and Jeyaraj's (2015) meta-analysis. Although their findings indicate that business value decreases when IT investments are considered, they conclude a "positive and significant nature" (p. 831) regarding business value of IT, including IT resources. Moreover, they find no significant influence on the consideration of IT infrastructures and capabilities, IT assets, and IT adoption or use.

Table 6. Key Findings and Implications Regarding the Effect of Interorganizational IT on Business Value

RQ 1: What is the effect of interorganizational IT on business value?			
Finding	**Previous research**	**Implications**	**Future research**
Interorganizational IT capabilities have a positive relationship with business value across all studies	• Positive relationship in most studies, with some proposing or finding negative effects on business value • Unclear and inconsistent differentiation between interorganizational IT resources and capabilities	• No contradiction in the relationship between interorganizational IT and business value when the IT variable is conceptualized as interorganizational IT capability • Theoretical support for the relational view and its application in IS research	• Clearly define the type of IT variable under evaluation as interorganizational resource or capability
Interorganizational IT capabilities fully mediate the relationship between interorganizational IT resources and business value	• Unclear and inconsistent differentiation between interorganizational IT resources and capabilities • "Positive and significant nature" (p. 831) of overall IT on business value, and no difference among IT adoption or use, IT assets, and IT infrastructures and capabilities in IT business value research (Sabherwal & Jeyaraj, 2015)	• There are situations in which interorganizational IT resources are not leveraged to develop interorganizational IT capabilities, which may result in negative effects • Developing IT capabilities from IT resources might be even more critical for creating business value in interfirm relationships than in single firms	• Clearly define the type of IT variable under evaluation as interorganizational resource or capability • Examine the relationship between interorganizational IT resources and interorganizational IT capability more closely to identify situations in which interfirm relationships are unable to cocreate value through leveraging joint IT resources to create interfirm capabilities • Examine the effect of human- and knowledge-related IT resources in cocreating business value of IT
Explorative: IT-based governance has a stronger relationship with business value than the other capabilities do	• Inaccurate definition of the specific type of interorganizational IT capability (e.g., IS integration) • Little consideration of interdependencies between interorganizational IT capabilities (Grover & Kohli, 2012)	• There are different effects of the interorganizational IT capabilities on business value, indicating interdependencies between the capabilities	• Develop theoretical explanations for interdependencies between the interorganizational IT capabilities and possible hierarchical relationships with business value

Hence, the development of IT capabilities might even be more crucial in interfirm relationships, as firms generally create superior benefits only by differentiating the interfirm from the attributes of arm's length relationships, e.g., investments in non-relation-specific assets (Dyer & Singh, 1998).

Third, in addition to our theoretically derived hypotheses, we followed up by conducting further exploratory analysis. In particular, we examined differences in the effect sizes (in terms of the estimated mean correlations) of the interorganizational IT capabilities and analyzed correlations among them. Previous research has inaccurately conceptualized the different interorganizational IT capabilities—for example, by referring to different concepts with the same variable (e.g., IS integration). Moreover, research has paid little attention to the interdependencies that exist among the different interorganizational IT capabilities (Grover & Kohli, 2012). Our results reveal that IT-based governance has a stronger relationship to business value than the other interorganizational IT capabilities do (i.e., IT-based relation-specific assets, knowledge sharing, and complementary capabilities). An explanation for this finding might be derived from the relational view, which states that governance mechanisms also enable relation-specific assets, knowledge sharing routines, and complementary capabilities (Dyer & Singh, 1998). Accordingly, IT-based governance might have both direct and indirect effects on business value. We observe further indications fur such interdependencies

(Grover & Kohli, 2012) with the IT variables in our data through the high correlations that exist among them (see Appendix C).

Our results provide several implications for future research. First, research should explicitly define the type of IT variable being studied and conceptualize it as an interorganizational resource or capability. This will enable scholars to more effectively ground their work in the key literature and will likely result in more consistent interpretations in future research on IT-based value cocreation. Second, our results indicate that there are situations in which firms cooperating in interfirm relationships are unable to develop interorganizational IT capabilities from their joint IT resources and thus interorganizational IT may also result in negative effects. As we found only a few studies (k = 6) investigating the relationship between interorganizational IT resources and capabilities, we encourage future research to place more emphasis on this connection. Not only will this enable us to understand the nuanced mechanisms and theoretical foundations of how interorganizational IT resources are utilized to develop advanced interfirm capabilities, but it will also allow us to more closely identify situations in which interfirm relationships are unable to cocreate value by leveraging joint IT resources to create interfirm capabilities. Third, as most studies investigated physical IT resources such as IOS and we found very few studies that empirically examined human- and knowledge-related IT resources, we recommend that future research explore how such resources are used to build up interorganizational IT capabilities to cocreate business value. Human skills and knowledge resources are essential for the success of IOS (Ibrahim et al., 2012), and developing explanations for how they can be leveraged to cultivate different types of interorganizational IT capabilities could enhance our understanding of the interorganizational IT and business value relationship. Finally, as we find indications for interdependencies between the different interorganizational IT capabilities, developing theoretical explanations of the relationships between them and possible hierarchical relationships with business value can lead to a deeper understanding of the mechanisms driving IT-based value cocreation.

4.1.2 Influence of Methodological and Contextual Moderators

Next, our study aimed to analyze methodological and contextual attributes that influence the relationship between interorganizational IT and business value. Our results confirm that methodological and contextual factors indeed moderate the relationship, which not only implies that these factors can explain divergent results in research on IT-based value cocreation but also allows us to test previously unexplored relationships. In the following, we analyze the theoretical implications and future research avenues of each methodological and contextual moderator, which are also summarized in Table 7.

Regarding methodological factors, our results show that studies utilizing matched-pair approaches result in more conservative estimates of business value than those obtaining data from a single respondent. These results mirror findings from other research fields (Gerow et al., 2014), indicating that results from single-respondent studies may be affected by common method bias. Furthermore, executives from different firms involved in interorganizational relationships might have different perceptions of interorganizational IT capabilities and the resulting business value (Dong et al., 2017; Ryoo & Kim, 2015). Accordingly, we encourage future researchers to collect data from multiple network partners, which can increase the reliability of results.

Moreover, our results indicate that objective measures result in lower estimates than perceptual measures do. This finding extends results from Sabherwal and Jeyaraj (2015) and Kohli and Devaraj (2003), who find larger IT payoff estimates for studies employing primary data sources but do not differentiate between types of measurement. In the context of interorganizational relationships, it is argued that objective measures generally capture relationship outcomes quite poorly (Dong et al., 2017; Jap & Anderson, 2003). Accordingly, future research should carefully employ objective measures and emphasize the development of appropriate measures captured independently from evaluator perception.

Regarding contextual factors, our results show that a different level of analysis regarding the outcome variable may indeed cause inconsistent study results. Thus far, research has inconsistently conceptualized the business value dimension and has often failed to explicitly define the level of analysis. Our findings suggest that relational-level value measures are closer to the domain of interest (Klein & Rai, 2009; Ray et al., 2005), resulting in larger estimates for relational-level measures compared to firm-level and network-level measures. Therefore, the level of analysis regarding business value represents an additional factor of significance in IT-based value cocreation compared to intraorganizational business value research, in which only the outcomes of an individual organization are assessed (Sabherwal & Jeyaraj, 2015). Accordingly, we encourage future research to pay extra attention to the outcome variables, as different levels of analysis may result in the over- or underestimation of results. Moreover, future research may conduct studies with multilevel theorizing, including mathematical operations to capture network-level phenomena (Zhang & Gable 2017).

Table 7. Key Findings and Implications Regarding the Methodological and Contextual Moderators

RQ 2: How do the methodological and contextual attributes of the studies affect the relationship between interorganizational IT and business value?				
Moderator	**Finding**	**Past research**	**Implications**	**Future research**
Respondent type	• Matched-pair approaches result in more conservative estimates than single-respondent studies	• Lower estimates for matched-pair approaches in other research fields (Gerow et al., 2014)	• Executives from different firms in interfirm relationships may have different perceptions of interorganizational IT capabilities and the resulting business value	• Collect data from multiple network partners to increase the reliability of results
Type of measurement	• Objective measures result in lower estimates compared to perceptual measures	• Larger IT payoff for studies with primary data sources, but no differentiation on the type of measurement (Kohli & Devaraj, 2003; Sabherwal & Jeyaraj, 2015)	• Objective measures may cause inconsistent results, as they may not properly capture business value in interfirm relationships	• Carefully employ objective measures in interfirm relationships • Develop appropriate measures for capturing cocreated value independently of evaluator perception
Level of analysis	• Larger estimates for relational-level measures compared to firm-level and network-level measures	• Inconsistent conceptualizations of the business value dimension; often no explicit definition of the level of analysis	• Different levels of analysis regarding the outcome variable may cause inconsistent study results	• Explicitly consider and define the level of analysis • Conduct multilevel theorizing • Examine how value is distributed and shared across partners
Country	• Higher correlations in developing countries compared to developed countries	• No influence of the economic region in business value research across all business value studies (Sabherwal & Jeyaraj, 2015) • Few studies at the interorganizational level with mixed results (Patrakosol & Lee, 2009; Zhu, Kraemer, & Xu, 2003)	• The underlying economic region may cause inconsistent study results • Characteristics of the economic region are more relevant for creating value in interfirm relationships than in single firms	• Explicitly consider the context of the economic region and discuss possible limitations • Conduct cross-country studies • Identify contextual characteristics of the economic region that influence the interorganizational IT and business value relationship
Type of interdependency	• Highest correlations in networked interdependencies, followed by supply chain interdependencies; lowest correlations in pooled interdependencies	• Comparison between two sides of a dyad (Im & Rai, 2014), but no explicit consideration of the type of interdependency in quantitative research	• Characteristics of the relationship influence the interorganizational IT and business value relationship and may cause inconsistent study results	• Explicitly consider the type of relationship and discuss possible limitations • Develop theoretical explanations for why relationship-level characteristics influence the interorganizational IT and business value relationship • Consider insights from network- and relationship-level theories

In this context, the exploration of how value is distributed and shared across collaborating stakeholders to analyze individual firm benefits from cocreated value may provide another interesting avenue for future research.

Next, our results show that studies conducted in developing countries exhibit a higher correlation between interorganizational IT capabilities and business value than studies conducted in developed countries do. Sabherwal and Jeyaraj (2015) found no effect of the economic region across all business value studies, and some studies on IT-based value cocreation revealed mixed results (Patrakosol & Lee, 2009; Zhu et al., 2003). Our study, however, indicates that the economic region may in fact cause inconsistent results in this research field. Moreover, some effects, such as regulatory support and minimal competitive pressure (Zhu & Kraemer, 2005), might be more relevant for business value generation in interorganizational relationships than in intraorganizational settings. Therefore, we encourage scholars to pay special attention to the underlying economic region of the study and to discuss any possible limitations. In addition, future research should conduct more cross-country studies to collect further empirical evidence on the differences in cocreating value from IT that arise due to the underlying region. For example, is IT-based cooperation more critical for success in developing countries, as companies need access to scarce IT resources? Do developing countries then need to more effectively transfer interorganizational IT resources to interorganizational IT capabilities to cocreate value? Are certain interorganizational IT capabilities more important in developing than in developed countries? Answering such questions will enable the research field to identify contextual factors that influence the interorganizational IT and business value relationship, leading to more advanced relationship-level theories on IT business value generation.

Moreover, our analysis shows that the effect of interorganizational IT capabilities on business value is greatest in networked interdependencies, followed by supply chain interdependencies. The weakest correlations can be found in pooled interdependencies. Previous studies on IT-based value cocreation compared results between different sites of a dyad, such as vendors and customers (Im & Rai, 2014). However, most studies fail to explicitly consider the type of interdependency, and we found no systematic comparison of different relationship types in cocreating value of IT. Nevertheless, our results reveal that the type of interdependency influences the interorganizational IT capability and business value relationship, being a source of inconsistent findings. Accordingly, future research should explicitly consider the relationship characteristics and discuss the resulting limitations. Moreover, we encourage scholars to conduct studies that further develop theoretical explanations for why relationship-level characteristics lead to variance in the interorganizational IT and business value relationship. For example, are interorganizational IT capabilities more critical for networked relationships because they require more idiosyncratic linkages and a higher level of collaboration than pooled and supply chain relationships do? Or do networked relationships face greater challenges in transforming interorganizational IT resources to interfirm capabilities due to their relationships exhibiting greater conflicts and less structurability, leading to more variance in business value? Are there other relationship-level attributes in place (e.g., number of partners, relationship duration, area of cooperation) that explain variance in the relationship between interorganizational IT resources, interorganizational IT capabilities, and business value? Ultimately, we recommend that researchers explain our results by developing strong theoretical foundations for the role of relationship-level factors in cocreating IT business value. In this context, future research may consider insights from network- and relationship-level theories (Provan et al., 2007).

4.2 Contributions to IS Literature

Our results provide two major contributions for IS research. First, we provide explanations for inconsistencies in the literature on IT-based value cocreation and thus advance the understanding of this research field. In particular, we show that contradictory findings stem from inconsistent conceptualizations of the interorganizational IT variables. There is, however, no contradiction regarding the relationship between interorganizational IT capability and business value. We find strong theoretical support for the relational view (Dyer & Singh, 1998; Grover & Kohli, 2012), demonstrating that IT-based relation-specific assets, knowledge sharing, complementary capabilities, and governance are important sources of cocreated value. In contrast, interorganizational IT resources only indirectly affect business value by enabling the development of interorganizational IT capabilities. While some studies on IT-based value cocreation already draw on these theoretical insights from the RBV and the relational view (Hadaya & Cassivi, 2012; Ibrahim et al., 2012), we were able to show that different conceptualizations of the IT variable cause inconsistent findings in the research field, using data that provide stronger evidence than a single primary study (Heugens & Lander, 2009; King & He, 2005).

Furthermore, our results suggest that inconsistent findings can be explained with varying methodological and contextual moderators. Although the methodological factors identified (i.e., type of respondent and type of measurement) are more or less typical for quantitative research, our study provides the most comprehensive empirical evidence to date for the proposition that these factors moderate the interorganizational IT and business value relationship. Our study thus encourages scholars to

further develop measures and methodologies and provides insights for designing future studies in this field of research. Regarding contextual factors, we found novel insights that arise from the specific field of IT-based value cocreation. We identified specific contextual factors (i.e., level of analysis, country, type of interdependency) that cause divergent results in this field of research and that must be considered when designing future studies. Moreover, we offer several promising future research avenues for this field of research.

Second, our results extend the findings of Kohli and Devaraj (2003) and Sabherwal and Jeyaraj (2015) to the interorganizational level. Traditional firm boundaries have recently begun to blur, and IT and non-IT resources of network partners are increasingly becoming integral parts of IT business value generation (Grover & Kohli, 2012). Accordingly, conventional knowledge of IT business value must be integrated with findings from IT-based value cocreation research. By bringing together the latest sample of studies investigating the field of IT-based value cocreation,[3] we address specific challenges and issues that arise from business value creation in interorganizational settings. Our results highlight the important role of interorganizational IT capabilities for cocreating value as well as the contradictions regarding the value of interorganizational IT resources. Furthermore, research on IT-based value cocreation is challenged by new levels of analysis for value measurement and by data collection from multiple sources, which can cause inconsistent results. Moreover, we found specific contextual factors in terms of the economic region and type of interorganizational interdependency. These insights extend previous knowledge of IT business value generation to the interorganizational level.

4.3 Limitations

As with all research, it is important to consider the limitations of this study when interpreting its results. An overview of the general limitations associated with meta-analyses, such as publication bias, sampling bias towards empirical studies, or "apples to oranges" issues, can be found in King and He's study (2006). However, we identified four limitations specific to this study. First, some of our analyses are based on *k*-values of fewer than 10 studies, which is below the threshold of recommended sample sizes for generalizability (Switzer et al., 1992). Thus, these results should be interpreted with caution, as the sample needs more studies to strengthen the stability of our estimates. This particularly holds for the role of interorganizational IT resources and our related interpretations. Second, there might be an issue related to mixing up different studies in the sense of a mediated path. To be more precise, utilizing one set of studies to validate the relationship between capability and value and taking another set to validate the relationship resources and capabilities can risk the validity of the finding that capability leads to value. While we conducted additional robustness checks (see Appendix F) and found no concerning results, our findings should be interpreted in terms of a potential threat and further research should aim to replicate our findings. Third, it can be argued that omitted mediators lead to suppressor effects in the research model we enacted. This includes, for example, negative outcomes of large investments in IT resources that provide no or even negative business benefits. While our empirical results provide evidence that interorganizational IT resources only offer value by leveraging IT capabilities and suggest that the remaining effect is negligible, these estimations might be biased due to other mechanisms. Our results must be interpreted in light of other contrasting explanations that can also act via this relationship. Finally, across all IT variables, the observed correlations have a generally high degree of heterogeneity. While we were able to explain some of the variance among the studies, further analysis would be beneficial in order to both increase the methodological rigor and provide further theoretical insights.

5 Conclusion

This study set out to synthesize and explain the contradictory research findings regarding IT-based value cocreation. By conducting a meta-analysis, we identified valuable insights for this rapidly growing research field. We found that inconsistent results stem from the conceptualization of interorganizational IT as a resource. In contrast, we found that interorganizational IT capabilities derived from the relational view (Dyer & Singh, 1998; Grover & Kohli, 2012) are positively related to business value across all studies. Moreover, our results show that findings are affected by both methodological and contextual moderators. Our study further extends business value findings at the firm-level (Kohli & Devaraj, 2003; Sabherwal & Jeyaraj, 2015) and provides contributions to research that provide guidance for future theory development.

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[3] Only 16 of the studies in our sample were also included in Sabherwal and Jeyaraj's (2015) meta-analysis.

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Appendix A: Comparison of Sabherwal & Jeyaraj (2015) and the Present Study

Recently, Sabherwal and Jeyaraj (2015) conducted a meta-analysis on the relationship between IT and business value, extending the findings of a previous meta-analysis by Kohli and Devaraj (2003). They identified a number of structural variables affecting this relationship, such as the use of primary data sources, profitability measures, and consideration of IT alignment. Although these findings prove valuable for IT business value research, we observe three limitations regarding their application to the field of IT-based value cocreation. First, a considerable number of IT-based value cocreation studies (25 in our sample) have been published since Sabherwal and Jeyaraj (2015) collected their data in 2013.[4] Second, their analysis was limited to studies that employed tangible performance measures, such as financial performance and productivity. However, scholars call for a broader representation of value to adequately account for business value generated by IT (Kohli & Grover, 2008). Interorganizational settings are particularly reliant on intangible business value dimensions, such as supply chain agility (Lee & Wang, 2013) and relationship quality (Im & Rai, 2014), as it is difficult to collect data on tangible performance outcomes (Straub et al., 2004). Third, and most importantly, the IT conceptualizations and theoretical foundations required for IT-based value cocreation are different from those applied in firm-level IT value research. These include interorganizational IT capabilities; outcome variables, such as network-level measures; and contextual execution in the environment, as in the case of strategic alliances (Grover & Kohli, 2012). Accordingly, we conducted a separate analysis to address the inconsistencies identified in IT-based value cocreation research.

[4] Our final sample includes 25 studies published since 2014.

Appendix B: List of Studies Used for the Meta-Analysis

Table B1. List of Studies

Study	Sample size	Interorganizational IT capabilities				Inter-organizational IT resources
		IT-based relation-specific assets	IT-based knowledge sharing	IT-based complementary capabilities	IT-based governance	
Al-Duwailah, Ali, & Al-Debei, 2015	307					.420; .620
Barua et al., 2004	1,076	.095	.219	.506		
Chen, Preston, & Xia, 2013	117	.361				
Cheng, Chen, & Huang, 2014	260	.590				
Chi, Zhao, & Li, 2016	138				.270	
Chi et al., 2017**	200	.340; .600			.620	
Choi & Ko, 2012	119		.460		.550	
da Silveira & Cagliano, 2006	201					.090; .100; .120; .160; .160; .180; .200; .230
Devaraj, Krajewski, & Wei, 2007	120			-.049; -.028	.081	
Dobrzykowski, 2010	190			.189		
Dobrzykowski, 2012	711			.023; .063; .164; .214		
Dong et al., 2017	141	.390	.480			
Droge & Germain, 2000	200					.018; .152
Gunasekaran et al., 2017	205					-.130; -.030
Hadaya & Cassivi, 2012	51				.389; .663	.064; .183
Hyvönen, 2007	51					.356
Ibrahim et al., 2012	137		.250; .260	.290; .330		.100; .110
Im & Rai, 2008*	238	.390				
	76	.430				
Im & Rai, 2014*	238			.350; .380	450; .340	
	76			.120; .200	.130; .380	
Jean, Sinkovics, & Cavusgil, 2010	240			.321; .325		.148; .310
Jeong et al., 2009	121			.530		

Jiang & Zhao, 2014	128			.582		
Kaefer & Bendoly, 2004	186					.098
Kang & Moon, 2016	122	.430				
Klein & Rai, 2009	91	.120				
	132	.210				
Ko, Olfman, & Choi, 2009	169		.578; .616		.515	
Kyu Kim, Yul Ryoo, & Dug Jung, 2011	51	.156; .307	.216; .383			
Lai, Wong, & Cheng, 2008	227	.194; .216; .220; .282; .283; .320; .336; .348				
Lee & Wang, 2013	147	.340			.257	
Lee et al., 2014	124		.350			
Liu & Ravichandran, 2015	1,030					-.010
Liu, Wei, & Hua, 2013	252		.380; .490		.460; .530	
Liu et al., 2015	261			.453	.469	
Lu & Wang, 2012	121	.332; .436; .480				
Nicolaou et al., 2011	116	.170			.217; .313	
Patrakosol & Lee, 2009	107	.150; .350				
	68	.400; .410				
Paulraj, Lado, & Chen, 2008	212	.200; .210				
Prasad, Green, & Heales, 2013	192				.311; .380; .393	
Rai & Tang, 2010	318	.338; .383				
Rai et al., 2006	110	.130; .140; .150; .170; .230; .290				
Rai et al., 2012	1,659			.000; .023		
Rai et al., 2015	342					.082
Rajaguru & Matanda, 2013	302	.506			.626	
Ramamurthy, Premkumar, & Crum, 1999	83					.227; .273
Ranganathan, Dhaliwal, & Teo, 2004	176	.730		.740		
Roberts & Grover, 2012	108	.170			.290	.110

Rosenzweig, 2009	170				.470; .480	
Ryoo & Kim, 2015	70	.420				
	70	.280				
Saeed, Malhotra, & Grover, 2005	38	.380			.180	-.080
Saldanha et al., 2013	3,023					-.010; .001
Sanders, 2007	245	.296				
Sanders, Autry, & Gligor, 2011	218	.298				
Saraf et al., 2007	63	.251				
Sriram & Stump, 2004	318					.410; .610; .630
Subramani, 2004	131			.005; .086; .179; .258; .343; .352		
Tafti, Mithas, & Krishnan, 2013	635					.103
Trantopoulos et al., 2017	1,057					.120; .180
Truman, 2000	48					.040; .055; .078
Uddin, 2010	315	.180; .200				
Unpublished study	241	.590		.690	.657	
Vaccaro, Parente, & Veloso, 2010	113					.142
Vickery et al., 2003	57					-.148; .192
Wang & Wei, 2007	150		.510		.460	
Wang et al., 2013	144				.300	
Wang et al., 2017**	200	.450				
Wei et al., 2013	157	.440; .520; .540; .630			.550; .570	
Wei et al., 2014	222	.364				
Wong, Lai, & Cheng, 2012	188		.450; .500			
Wong et al., 2015	188	.520	.469		.557	
Wu & Chuang, 2010	184	.430; .600				
Xu, Huo, & Sun, 2014	176	.340				
Xue, Ray, & Sambamurthy, 2013	421	.133; .145; .160; .160				
Yao, Dresner, & Palmer, 2009	215			.263; .278		

Zander, Mandrella, Marrone et al., 2016***	150	.566				
Zander, Mandrella, & Kolbe, 2016***	150			.422		
Zhang & Pavone, 2016	101	.440; .520		.540; .570		
Zhao & Xia, 2014	194	.190; .230; .300; .310				.220; .260; .270; .400
Zhu et al., 2004	612	.480				
Zhu et al., 2015	196	.501		.571; .580; .639		
Notes: *, **, *** papers derive results from the same sample and were treated as one study.						

Appendix C: Results of the Meta-Analysis of Correlations of IT Capabilities

Table C1: Correlations of IT Capabilities

Correlation	$\hat{\rho}$	*k*	*N*	$Var._{\rho}$	SD_r	Range *r*	$CV_{80\%}$	$CI_{95\%}$	PVA	Fail-safe *N*
IT-based relation-specific assets ↔ IT-based knowledge sharing	.558	3	1,405	0	.051	.427, .590	.558, .558	.500, .615	1	11
IT-based relation-specific assets ↔ IT-based complementary capabilities	.460	5	1,790	.076	.234	.184,.730	.107, .814	.255, .666	.088	17
IT-based relation-specific assets ↔ IT-based governance	.636	9	1,497	.037	.181	.040, .732	.390, .881	.518, .754	.261	38
IT-based knowledge sharing ↔ IT-based complementary capabilities	.541	2	1,213	.014	.118	.400, .770	.390, .692	.376, .705	.350	7
IT-based knowledge sharing ↔ IT-based governance	.740	5	878	0	.080	.480, .710	.740, .740	.670, .810	1	23
IT-based complementary capabilities ↔ IT-based governance	.706	5	936	.006	.113	.301, .672	.607, .804	.607, .805	.698	23

Notes: $\hat{\rho}$ = sample size weighted mean of corrected population correlations; *k* = number of correlations; *N* = total sample size; $Var._{\rho}$ = variance of true score correlation ρ; SD_r = standard deviation of sample size corrected correlation r; Range r = range of uncorrected correlations; $CV_{80\%}$ = 80% credibility interval around true score correlation ρ; $CI_{95\%}$ = 95% confidence interval around true score correlation ρ; PVA = percentage of variance accounted for by sampling and measurement error; Orwin's fail-safe *N* = computed with a criterion correlation of 0.2.

Appendix D: Coding of the IT Variables

Table D1: Coding of the IT Variables

Type of IT variable	Decision rule applied	Illustrative variables
Interorganizational IT capabilities		
IT-based relation-specific assets	Does the variable measure hardware, software, and network facilities that are specialized for the relationship and enable digital connections in interfirm relationships? If yes, the variable measures IT-based relation-specific assets.	
	a. Does the variable measure the customization of IOS between firms in interfirm relationships?	• Buyer IT customization (Klein & Rai, 2009)
	b. Does the variable measure the compatibility or interoperability between the IT infrastructures of partners in interfirm relationships?	• Interorganizational IT infrastructure compatibility (Lee et al., 2014) • Technical compatibility (Rajaguru & Matanda, 2013) • Interoperability (Zhao & Xia, 2014)
	c. Does the variable measure the flexibility or adaptability of the interorganizational IT infrastructure of partners in interfirm relationships?	• IT reconfiguration (Rai & Tang, 2010) • Information technology infrastructure flexibility (Cheng et al., 2014; Chi et al., 2017) • IOS adaptability (Dong et al., 2017)
	d. Does the variable measure the extent to which the IT infrastructure is integrated with partners in interfirm relationships?	• (External) IS integration (Barua et al., 2004; Nicolaou et al., 2011; Roberts & Grover, 2012; Saraf et al., 2007) • IT integration (Chen et al., 2013; Rai & Tang, 2010; Zander, Mandrella, Marrone, et al., 2016; Unpublished Study) • IOS integration (Lee & Wang, 2013; Ryoo & Kim, 2015)
	e. Does the variable measure the extent to which a firm has established interorganizational electronic or digital connections in interfirm relationships?	• (Digital) platform capability (Wang et al., 2017; Zhu et al., 2015) • IT infrastructure (capability) (Wei et al., 2013; Wong et al., 2015) • External IT linkages (Wei et al., 2013) • Externally focused IT capability (Wei et al., 2014) • Data connectivity (Zhao & Xia, 2014)
	f. Does the variable measure the use of IOS with specific partners in interfirm relationship?	• E-integration (Wong et al., 2015; Xue et al., 2013) • IOS deployment (Lu & Wang, 2012)
IT-based knowledge sharing	Does the variable measure the ability to exchange information and knowledge based on IOS in interfirm relationships? If yes, the variable measures IT-based knowledge sharing.	
	a. Does the variable measure the extent to which IT enables absorptive capacity between firms in interfirm relationships?	• Information exploitation capability (Ko et al., 2009)
	b. Does the variable measure the extent to which IT enables information and knowledge sharing in interfirm relationships?	• (Electronic) information sharing (Ko et al., 2009; Liu et al., 2013) • IOS visibility (Kyu Kim et al., 2011; Lee et al., 2014) • IOS-enabled knowledge sharing (Dong et al., 2017)

	c. Does the variable measure the IT-enabled ability of interorganizational information and knowledge sharing in interfirm relationships?	• Online information capabilities (Barua et al., 2004) • Knowledge-based IOS capabilities (Ibrahim et al., 2012)
IT-based complementary capabilities	Does the variable measure the ability to identify, exploit, and leverage complementary capabilities and resources by utilizing IT functionalities that synergistically complement each other? If yes, the variable measures IT-based complementary resources and capabilities.	
	a. Does the variable measure the extent to which IT supports interorganizational business processes (ordering, invoicing, purchasing, tracking, etc.)?	• Use of OSS (Im & Rai, 2014) • E-supply chain capability (Jiang & Zhao, 2014) • IT use for exploitation (Subramani, 2004) • Process-based IOS capabilities (Ibrahim et al., 2012) • IS enabled processes (Dobrzykowski, 2010)
	b. Does the variable measure the extent to which IT enables the exploration of new interorganizational capabilities or business opportunities?	• IT use for exploration (Subramani, 2004)
	c. Does the variable measure complementary IT functionalities between firms in interfirm relationships?	• IT leveraging competence (Jeong et al., 2009) • IT capability profiles (Rai et al., 2012)
IT-based governance	Does the variable measure ability to coordinate, plan, control, and make decisions in interfirm relationships based on IOS? If yes, the variable measures IT-based governance.	
	a. Does the variable measure the extent to which IT enables the coordination of interorganizational business activities?	• E-Collaboration (capabilities) (Chi et al., 2017; Choi & Ko, 2012; Rosenzweig, 2009) • Electronic cooperation (Ko et al., 2009) • SCCSs use (Hadaya & Cassivi, 2012)
	b. Does the variable measure the extent to which IT enables interorganizational decision-making?	• Use of ISS (Im & Rai, 2014) • Analytical ability (of IOS) (Lee & Wang, 2013; Roberts & Grover, 2012) • IT-enabled collaborative decision-making (Wong et al., 2015)
	c. Does the variable measure the extent to which IT enables planning and forecasting in a relationship?	• IT-enabled planning and control (Wang et al., 2013) • Collaborative planning (Liu et al., 2013) • Virtual integration (Wang & Wei, 2007)
	d. Does the variable measure the extent to which IT enables the verification and evaluation of a partner's actions?	• Information control use (Nicolaou et al., 2011)
	e. Does the variable measure the extent to which interorganizational IT-related decisions are made?	• IT Governance structures for collaborative alliances (Prasad et al., 2013; Unpublished study) • Contractual governance (Chi et al., 2017)
Interorganizational IT resources		
Interorganizational IT resources	Does the variable measure widely available and commodity-like physical IT infrastructure components, human IT skills, and IT-enabled intangibles that span organizational boundaries? If yes, the variable measures interorganizational IT resources.	
	a. Does the variable measure whether the firm has adopted IOS?	• IOIS adoption (da Silveira & Cagliano, 2006) • IOS standards adoption (Zhao & Xia, 2014) • Technological resources (Al-Duwailah et al., 2015)

		• Data access systems (Trantopoulos et al., 2017)
	b. Does variable measure the level of investments in IOS?	• EDI purchasing/selling (Droge & Germain, 2000) • IT investments (Sriram & Stump, 2004)
	c. Does the variable measure the extent to which a firm uses IOS, irrespective of specific relationship(s)?	• Overall supplier IT advancement (Jean et al., 2010) • Use of EDI (Vickery et al., 2003) • IT for information partnering/transactions (Saldanha et al., 2013) • Web-based customer infrastructure (Roberts & Grover, 2012)
	d. Does the variable measure the availability of IT-related human and/or knowledge resources in interfirm relationships?	• Relationship specificity of human-based knowledge resources (Ibrahim et al., 2012) • Reliance on knowledge management tools (Vaccaro et al., 2010)

Appendix E: Examples of Classifying Interorganizational IT Resources and Interorganizational IT Capabilities

In the first study, data access systems is one of the observed IT variables (Trantopoulos et al., 2017). The variable solely measures whether the organization has adopted ERP, SCM, and CRM systems, regardless of the specific interfirm relationships. These systems are available to all firms and could potentially be used for an unlimited number of partners. Hence, the variable does not measure whether the organization uses IOS to enable idiosyncratic linkages with its network partners and we therefore classified the IT variable as an interorganizational IT resource.

In the second study, IS integration with channel partners is one of the observed variables (Saraf et al., 2007). Although the underlying technologies (e.g., software applications, databases, network facilities) can be purchased from the factor market as well, the variable measures how well a firm has integrated its IT infrastructure with its channel partners. Such a technical infrastructure is specifically built for the relationships with channel partners and customers and cannot be transferred to other relationships without significant loss of value. Therefore, it enables idiosyncratic linkages between the channel partners and the IT variable was accordingly classified as an interorganizational IT capability.

Below are the items of the two IT variables extracted from the original example studies.

Table E1: Examples of Classifying Interorganizational IT Resources and Interorganizational IT Capabilities

Type of IT variable	Study	Variable	Items
Interorganizational IT resource	(Trantopoulos et al., 2017)	Data access systems	Sum of three binary variables: • Adoption of systems for enterprise resource planning (ERP) (0/1) • Supply chain management (SCM) (0/1) • Customer relationship management (CRM) (0/1)
Interorganizational IT capability	(Saraf et al., 2007)	IS integration with channel partners	• Data are entered only once to be retrieved by most applications of our channel partners • We can easily share our data with our channel partners • We have successfully integrated most of our software applications with those of our channel partners • Most of our software applications work seamlessly across our channel partners • Software applications on multiple machines of multiple vendors are interoperable across our channel partners

Appendix F: Mediation Analysis

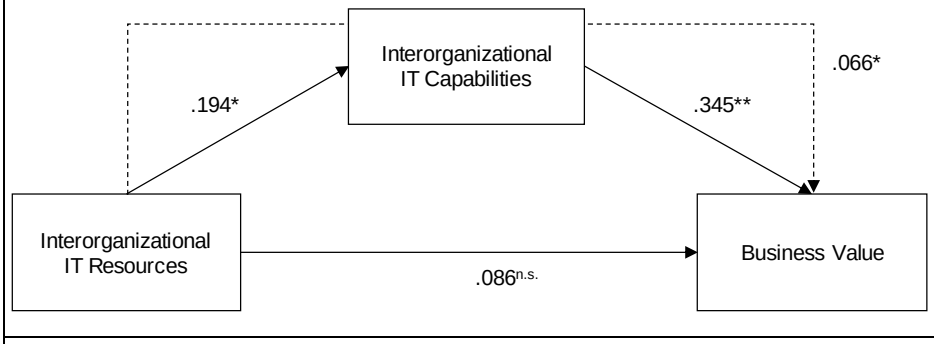
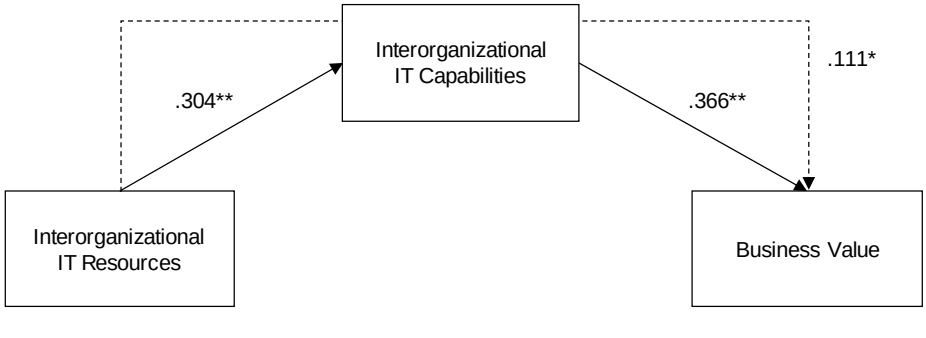
We conducted additional meta-analytic structural equation modeling (MASEM) in order to descend deeper into the role of interorganizational capabilities as mediator. We decided to use the widely applied two-stage MASEM approach (Cheung & Chan, 2005). This multivariate approach is favorable over the univariate methods since dependencies of correlations reported in the same study are taken into account. This is particularly relevant for our sample of correlations since only six studies report the correlations for all three variables.

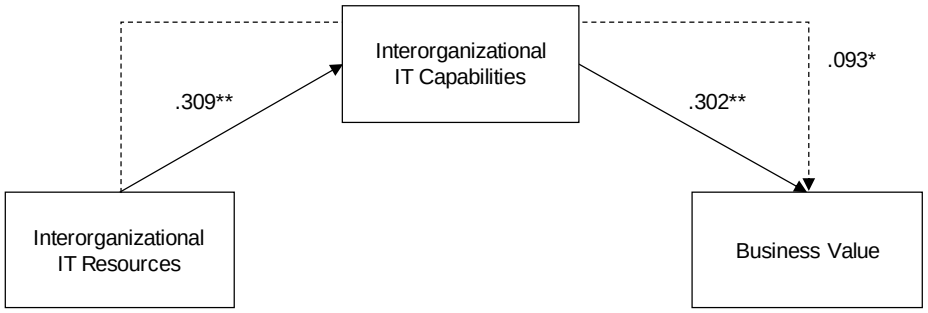
The two-stage MASEM approach starts with pooling the correlation coefficients at Stage 1, yielding the correlation matrix between our three variables. In Stage 2, we then used a random-effects weighted least squares estimator to fit the structural models with the observed correlation matrix. In comparison to the Hunter and Schmidt (2004) approach, the estimates of two-stage MASEM approach differ, as it does not account for study artifacts such as measurement reliability. We used the R package metaSEM for our statistical analysis (Cheung, 2015).

We follow Zhao et.'s (2010) updated understanding of Baron & Kenny's (1986) mediation analysis, which argues that a mediator is identified consistent with the hypothesized theoretical framework ("indirect-only mediation"), if two conditions hold. First, the indirect path between the explanatory variable over the mediator and the dependent variable is significant. Second, the direct path between the explanatory variable and the dependent variable is insignificant.

To check for indirect-only mediation, we thus estimated a full model with three paths. Since this model is completely unsaturated with degrees of freedom, this estimation gives no model fit properties. We found a significant effect between interorganizational IT resources and capabilities and between capabilities and business value. While the indirect effect between resources and value is significant, we found no significant direct effect. We thus argue that an indirect-only mediation is given and the direct path between the explanatory variable and the dependent variable can be excluded. Accordingly, we estimated an indirect-only model. The new estimation shows a good model fit (Hu & Bentler, 1999). The results support the hypothesis that capabilities mediate the relationship between interorganizational IT resources and business value. The results of both estimations are depicted in Table F1 below. As mentioned earlier, only six studies provide full information on all coordinating relationships. Studies with only partial information are systematically different and thus could have biased our estimations. To check for the robustness of our estimation, we therefore estimated an indirect-only model that solely included studies with full information. The interpretation of the results did not differ from the results of the full dataset.

Table F1: Results of the Mediation Analysis

	Full model with full sample *k* = 80 *N* = 21,843 No model fit (saturated model)
	Indirect-only model with full sample *k* = 80 *N* = 21,843 Chi-square = 2.691 *df* = 1 *p* > 0.10 RMSEA = 0.009 TLI = 0.985



Indirect-only model with restricted sample[a]

k = 6

N = 768

Chi-square = 5.958

df = 1

p < 0.05

RMSEA = 0.080

TLI = 0.859

Notes: The dotted path displays the indirect effect. [a] The restricted sample model only includes studies that provide full information on all correlations; [n.s.] = not significant; * $p < 0.05$; ** $p < 0.01$.

About the Authors

Markus Mandrella works in the area of strategic IT management in the healthcare sector where he manages transformative IT projects and digital healthcare processes. He received his PhD in management science from the University of Göttingen, which has been funded by the German Research Foundation (DFG). His research focuses on IT business value, IT-based value cocreation, and interorganizational networks. His articles have been published in outlets such as the *Journal of the Association for Information Systems*, the International Conference on Information Systems and the European Conference on Information Systems.

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