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You'll never walk alone: Why we need a supply chain practice view on digital procurement

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ABSTRACT

This paper conceptualizes *digital procurement readiness* as a dyadic construct and introduces the *supply chain practice view* (SCPV) as a theoretical lens that can help guide future research on digital procurement. We build on a literature review and on dyadic, explanatory case studies to provide a nuanced understanding of how the digital readiness of supply chain partners—on both sides of the dyad—needs to co-evolve for the implementation of digital procurement practices. Specifically, we outline how the SCPV can serve as both a *holistic* and a *supply chain-specific* framework for future research on the following: 1) the antecedents that help explain why supply chain partners adopt inter-organizational digital procurement practices, and 2) the relational performance outcomes derived from their use. For managers, this study implies the need to explicitly consider interactions with and influences of supply chain partners in their quest to rapidly and effectively digitalize procurement.

1. Introduction

Digital procurement practices involve "the use of advanced 'digital technologies' for procurement purposes" (Srai and Lorentz, 2019, p. 15). Advanced digital technologies, such as big data analytics, the Internet of Things, cloud computing, and additive manufacturing, promise to fundamentally change the way buying firms collaborate with their supply network around the globe (Batran et al., 2017; Pellengahr et al., 2016). Leading companies have obtained significant process efficiencies and cost savings from the use of digital technologies in procurement. For example, BASF has done so by using IBM Watson's artificial intelligence system to catalog and evaluate its suppliers (McGee, 2018). Despite a few early success cases, the vast majority of firms still have a long way to go on their digitalization journey. A pilot study on digital procurement in Europe showed that more than two-thirds of the participating companies had not yet implemented any advanced digital technologies (Pellengahr et al., 2016, p. 15). If these firms aim to implement digital procurement practices, a vital first step is to understand which *organizational prerequisites* need to be in place for a successful implementation. When can a company and its purchasing function be considered *ready* to embark on the journey toward advanced digital procurement?

The existing purchasing and supply management (PSM) literature provides only limited guidance for such a transformation. It has focused primarily on how the *use* of digital technologies (e.g., big data analytics, cloud computing, automated procure-to-pay processes, real-time spend analytics, and virtual supplier rooms) can create value (Richey et al., 2016; Srai and Lorentz, 2019). With this focus on the use of technologies and applications, the literature sheds little light on the organizational factors that need to be in place *prior to* use. What prevents the majority of firms from implementing digital procurement practices at this point? We know little about the factors that constitute firms' ability to embrace and use new digital technologies in procurement. Adopting the terminology used in the wider field of technology management, we denote the degree to which firms fulfill these requirements as *digital procurement readiness* (Parasuraman, 2000; Richey et al., 2007).

A second limitation of the existing literature on digital procurement is its strong, if not exclusive, focus on *the buying firm*, thus widely neglecting supply chain partners' ability or inability to embrace and use new digital technologies in their interactions with buying firms. Procurement, by its nature, is a function that spans firm boundaries and connects organizations. Many digital procurement technologies connect systems of the buying firm with systems of the supplier. Thus, digital readiness is required on *both* sides of the buyer–supplier dyad so that the use of the technologies to their full extent becomes possible. Because of the crucial role of inter-organizational linkages in digital procurement, we call for a theoretical perspective that explicitly accounts for the dyad and network levels.

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Third, because the existing digital procurement literature has a strong practitioner orientation, the *theoretical underpinning* of many of these works is relatively weak (Spina et al., 2016). The few studies that develop theoretical arguments adopt grand theories from *outside* the PSM field, such as the resource-based view (Barney, 1991, 2012). However, theories specifically developed for the PSM field – or the broader operations and supply chain management (OSCM) discipline – could better incorporate key constructs associated with managing the supply base, such as inter-organizational buyer–supplier relationships or complex supply networks (Carter et al., 2015; Spina et al., 2016). This approach to strengthening the theoretical foundation of research on digital procurement is yet to be explored.

To address these gaps, we seek to provide answers to the following research questions: 1) How can *digital readiness* be *conceptualized*, and how does it influence the implementation of digital procurement practices? 2) How can a *theoretical perspective* that explicitly accounts for the *interplay between the buying firm and supply chain partners* help to guide future research on digital procurement?

Building on the notion that the breadth and depth of the digital transformation in procurement necessitates both a *holistic* and a *supply chain-specific* theoretical lens, spanning across organizational boundaries, we suggest the adoption of the supply chain practice view (SCPV) (Carter et al., 2017b). The SCPV, a theoretical perspective developed in the OSCM discipline, posits that firms can use imitable, inter-organizational SCM practices to improve performance in supply chains. Explicitly opting for the *inter-organizational* level of analysis, the SCPV seeks to explain why firms adopt SCM *practices* and helps to clarify how the use of SCM practices leads to *relational performance* in the supply chain.

To supplement our conceptual development, we conducted explanatory case studies of six buyer–supplier dyads (Dubois and Salmi, 2016; Ketokivi and Choi, 2014). The case studies provide a more nuanced understanding of how digital readiness on both sides of the buyer–supplier dyad mutually influences the implementation of digital procurement technologies.

In sum, this research aims to make three contributions to the PSM literature. First, it advances the still-embryonic literature on *digital procurement* by introducing the SCPV as a comprehensive theoretical grounding for the discussion of digital procurement. Second, in contrast to prior PSM research that takes the buying firm as the unit of analysis, this study adopts a *dyadic perspective* and accounts for the digital readiness of both buyers and suppliers. Findings from our explanatory case studies underscore the importance of this dyadic perspective. Third, this study extends the prevailing focus on the use of digital technologies in PSM (Srai and Lorentz, 2019) and investigates their antecedents as important factors in explaining and understanding the adoption of digital technologies. In particular, we conceptualize *digital procurement readiness* as a critical antecedent on the side of the buying firm and *supplier digital readiness* as the necessary complement on the other side of the dyad.

2. A supply chain practice view on digital procurement

Although the field of PSM is maturing and increasing in relevance, academic research in the PSM field often lacks a strong theoretical grounding (Spina et al., 2016) – and research on digital procurement appears to be no exception. However, a solid theoretical foundation is indispensable in increasing the OSCM discipline's maturity and in developing meaningful future research on digital procurement (Spina et al., 2016; Srai and Lorentz, 2019).

To strengthen the theoretical foundation of research on digital procurement, two possible, complementary approaches exist (Spina et al., 2016): First, researchers can adopt (grand) theories from management and economics, such as the resource-based view (Barney, 1991, 2012) or transaction cost economics (Williamson, 2008), and apply them to the PSM field and, in particular, to the context of digital procurement. Extant studies on digital procurement that undertake such adoption either build on a single theory (e.g., Richey et al., 2016) or eclectically combine multiple theories (e.g., Srai and Lorentz, 2019). Adopting grand theories from management and economics helps to root PSM research in consolidated theoretical frameworks and facilitates recognition by the broader management research. Second, researchers can draw on (mid-range) theories developed within the PSM field or in the broader supply chain discipline. This approach might allow for a better fit with the specifics of PSM-related phenomena because it explicitly considers key constructs associated with managing the supply base, such as sourcing decisions, buyer–supplier relationships, the supply chain, and supply networks (Carter et al., 2015; Spina et al., 2016).

Following the second approach, this paper builds on the *SCPV* (Carter et al., 2017b) – a theoretical lens that examines how firms can use imitable, inter-organizational SCM practices to improve relational performance in supply chains. The SCPV builds on the practice-based view (Bromiley and Rau, 2014, 2016), which is a theoretical foundation from strategic management research, and extends it to the inter-organizational level of analysis. In an SCPV research model, the explanatory variables seek to answer the question of why firms adopt SCM practices. In addition, the link between SCM practices and performance helps to better explain how using SCM practices leads to enhanced relational performance in the supply chain. In contrast to other theories that focus on inimitable resources, such as the resource-based view (Barney, 2012) or the relational view (Dyer and Singh, 1998), the SCPV posits that the use of *imitable* SCM practices is needed as a means to explain performance outcomes. The explanatory variables can be viewed as antecedents or enablers of the SCM practice (Wang et al., 2018).

The SCPV can be a particularly fruitful theoretical lens for research on digital procurement for two primary reasons: 1) It provides a *holistic view* that incorporates the antecedents to and the use of digital technologies in procurement, as well as the performance outcome; and 2) it explicitly considers the interplay of the buyer and the supplier by focusing on the *dyad* or *network* level of analysis for each of these elements. Fig. 1 presents our theoretical model for applying the SCPV to digital procurement. The model extends previous studies on the *use perspective* of digitalization in PSM (Srai and Lorentz, 2019) and provides a conceptual framework for research on digital procurement comprising the following three key elements: 1) *Digital procurement readiness* on both sides of the buyer–supplier dyad as an explanatory factor for the adoption of digital technologies; 2) *digital procurement practices* to describe the use of digital technologies across organizational boundaries; and 3) *performance,* both individual and relational, as the outcome variable. To expand this basic SCPV model, moderating and mediating effects can be considered.

In sum, the SCPV provides a coherent and sufficiently robust organizing framework for guiding research on digital procurement. First, relating to the explanatory variables, the SCPV helps to answer the question of *why* firms adopt digital procurement practices or refrain from doing so. This link between explanatory variables and the adoption of inter-organizational digital procurement practices is the focus of the empirical case studies in this paper. Second, relating to the dependent variable of interest, the SCPV encourages researchers to study *which* intermediate outcomes and relational performance effects digital procurement practices have on supply chains. Exemplary research questions might ask whether digital procurement practices measurably increase relational performance, or whether practice A is more effective than practice B. In this paper, we provide initial guidance regarding possible future research on performance outcomes, based on a review of the literature and on additional insights from our empirical cases. In the following sections, we build on a literature review to explain in more detail how the individual elements of the theoretical model apply to digital procurement.

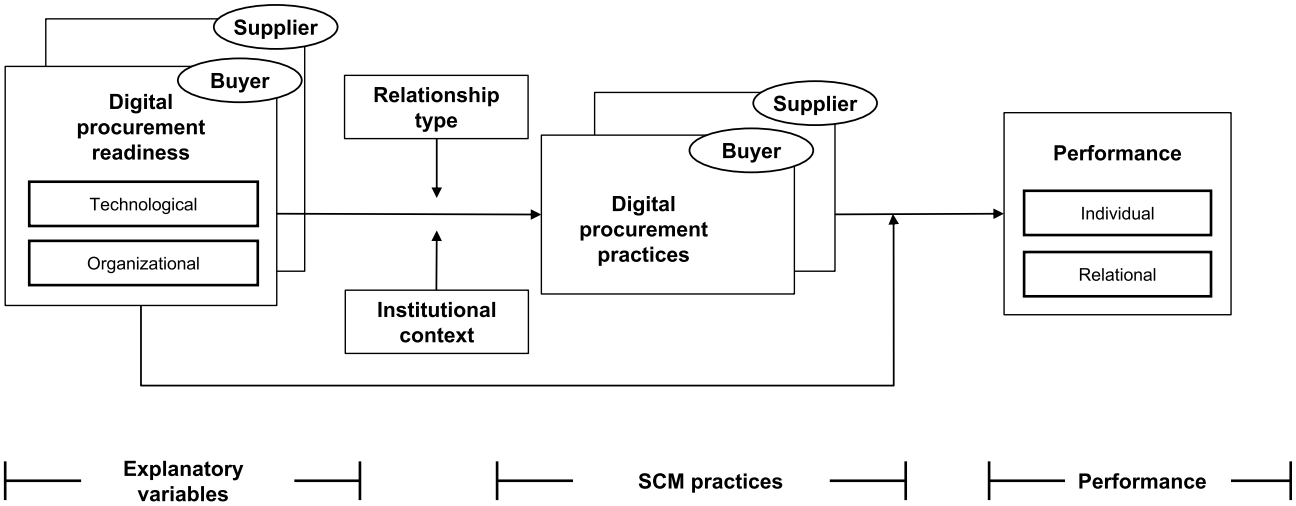

Fig. 1. A supply chain practice view on digital procurement.

2.1. Literature review process

To identify digital procurement practices, relevant explanatory factors, and performance effects of digital procurement, we conducted an extensive literature review (Durach et al., 2017a) on digital procurement and organizational readiness. We focused on peer-reviewed articles in leading academic journals in the disciplines of supply chain management and information systems (IS) management. These journals were identified based on strong citation impact factors in the Association of Business Schools (2018) journal ranking (Carter et al., 2017a). For SCM, we included eight leading journals that also have been included in previous literature reviews (Johnsen et al., 2016). For IS management, we included four leading journals, in line with previous IS management research (Chen et al., 2010). (See Appendix A.) Because of the nascent stage of the field, we limited our search to articles published within the past 16 years (i.e., since 2003). To identify relevant publications on digital procurement, we searched titles, abstracts, and keywords using the digitalization-related search terms identified by Srai and Lorentz (2019) (e.g., "digital," "e-procurement," and "big data"). To locate relevant publications on organizational readiness, we searched titles, abstracts, and keywords using "readiness" as our search term. This keyword search identified a preliminary sample of 537 journal articles. We then reviewed the titles and abstracts of each article and eliminated the ones that were not related to a business-to-business context or that did not have a PSM focus. This review yielded 77 articles, the full text of which we examined in detail. We further excluded articles that were not directly related to our research questions because they focused on, for example, the individual or country level of analysis. This process resulted in a final sample of 38 core articles containing detailed information about the dimensions of (digital) procurement readiness. In the next subsections, we apply the SCPV to digital procurement to synthesize the findings from our literature review.

2.2. Digital procurement practices

The term, "digital procurement practices," refers to the *use* of "digital technologies," either individually or in combination, for procurement purposes (Srai and Lorentz, 2019). Srai and Lorentz (2019) distinguish between basic and advanced digital technologies. *Basic digital technologies* mainly include e-procurement, which refers to "the sourcing of goods or services via electronic means, usually through the Internet" (Ronchi et al., 2010; Schoenherr and Tummala, 2007). E-procurement applications, such as buyer-side e-RfX systems and electronic marketplaces, have been used by firms for more than ten years to facilitate internal and external procurement processes (Mishra et al., 2007; Ramkumar et al., 2019; Tatsis et al., 2006). Dozens of e-procurement solutions currently are on the market, and new technologies – like robotic process automation (RPA) – promise to automate additional tasks in the e-procurement process (Högel et al., 2018).

Advanced digital technologies include a range of digital technologies that have emerged more recently, such as cloud computing, the Internet of Things, additive manufacturing, and big data analytics (Srai and Lorentz, 2019). As the central interface between internal and external business partners, procurement is in a unique position to analyze and use the "big data" that flow between a buying company and its suppliers (Handfield et al., 2019; Kache and Seuring, 2017). Practitioners expect procurement to tap new sources of value by studying these data using big data analytics tools (Weise et al., 2018). Examples include pay-per-use contracting models or artificial intelligence (AI)-based demand and supply forecasting procedures.

Digital procurement practices can encompass both intra- and inter-organizational SCM practices. The SCPV defines *inter-organizational SCM practices* as "a specific activity or a set of activities that spans different formal organizations and that other supply chain dyads or networks can imitate" (Carter et al., 2017b, p. 116). The notion of imitability in the SCPV means that these SCM practices are amenable to transfer across firms – in contrast to assumptions about inimitable resources in resource-based theory. Conceptually, inter-organizational SCM practices differ from intra-organizational SCM practices in that they require mutual efforts from two or more organizations to be effective (Carter et al., 2017b; Zimmermann and Foerstl, 2014). For example, use of real-time spend analytics through mobile apps can be classified as an *intra-organizational* practice because it mainly draws on data residing in the buying firm's internal database. In contrast, e-procurement can be classified as a *dyadic* inter-organizational SCM practice because it relies on bi-directional electronic information exchange between buyers and suppliers. In reality, the distinction between intra- and inter-organizational SCM practices is not always clear-cut; rather, the continuum can range from the organization to dyads, triads, and the extended network (Carter et al., 2017b).

Although many digital procurement practices are dyadic in nature, the SCPV can also be applied to study digital procurement practices in triads or extended networks – an important shift in that "network practices … are likely to gain importance for the performance of supply chains in the future" (Carter et al., 2017b, p. 120). For example, cloud-based risk analytics might be classified as an inter-organizational network practice because data from multiple external sources is integrated,

such as suppliers' delivery status, external service providers' weather data, and news feeds from social media.

The use of inter-organizational digital procurement practices inevitably is bound to the willingness and ability of all involved parties to collaborate and integrate with key partners in the supply chain (Kache and Seuring, 2017). Therefore, the SCPV, when applied to digital procurement, explicitly takes an inter-organizational perspective that enables us to account for the role of suppliers.

2.3. Digital procurement readiness

Factors affecting the adoption of digital technologies can be located at different levels of analysis. Extant studies on basic digital procurement technologies (i.e., e-procurement) have begun to explore antecedents to their use at the individual level (e.g., employee-level user acceptance) (Brandon-Jones and Kauppi, 2018), at the organizational level (e.g., management support) (Rotchanakitumnuai, 2013), and at the industry level (e.g., industry traditionalism) (Tatsis et al., 2006). At the organizational level, PSM researchers emphasize that the keys to technology use are related to *readiness*, meaning that a company must be "ready" – by fulfilling certain prerequisites – if it is to use the technology (Kros et al., 2011; Ray et al., 2005; Richey et al., 2007). In the context of our study, we define *digital procurement readiness* as a company's ability to embrace and use new digital technologies in procurement (Parasuraman, 2000; Richey et al., 2007).

To conceptualize the dimensions of digital procurement readiness, we synthesize the dimensions used in extant research (see Table 1). To structure the factors that potentially influence the use of digital technologies in procurement, we draw on the technology–organization–environment (TOE) framework (Tornatzky and Fleischer, 1990). This framework divides antecedents that affect the use of new technologies into three categories: technological, organizational, and environmental. Prior research has applied the TOE framework to study both the use of big data analytics in supply chain management (Chen et al., 2016) and Internet use in procurement (Mishra et al., 2007). Although previous studies generally have found empirical support for use of the TOE framework, the specific factors used within each of the three categories vary across different studies (Chen et al., 2016).

Technological readiness. The literature has identified *technological readiness* as a key factor in the adoption decision (Li et al., 2017; Zhu et al., 2006). Technological readiness refers to a company's "ability to embrace and use new technological assets" (Richey et al., 2007, p. 195). Prior studies have demonstrated the importance of technological readiness in the adoption of enterprise resource planning (ERP) systems (Li et al., 2017), e-business (Zhu et al., 2006), and radio frequency identification (RFID) technology (Kros et al., 2011). In these cases, technological readiness comprises two features: 1) the *information technology (IT) infrastructure* that enables digital procurement, and 2) the *human resources* that possess the *knowledge and skills* to implement digital technologies (Venkatesh and Bala, 2012; Zhu et al., 2006).

IT infrastructure refers to information technologies that enable digital procurement practices (Zhu et al., 2006). Because firms differ significantly in the IT infrastructure available to them, infrastructure has been identified as one of the main challenges for digital procurement (Kache and Seuring, 2017; Mishra et al., 2007). Information technologies, such as electronic data interchange (EDI), establish a platform on which digital procurement practices can be built by enabling information transfer within and across firm boundaries (Autry et al., 2010; Liu et al., 2016; Saldanha et al., 2015). Integrated systems at the back end, such as an ERP system and a data warehousing system, provide the "nerve system" for digital procurement by connecting separate systems on common data standards and communication platforms (Dong et al., 2009). A more recent type of IT infrastructure is cloud computing, which is "a virtualized IT resource and can take the form of software as a service (SaaS), infrastructure as a service (IaaS), and/or platform as a service (PaaS)" (Wu et al., 2013, p. 26).

Table 1
Dimensions of readiness constructs.

Reference	Concept	Definition	Conceptual dimensions	Practice/Field of application
Bakker et al. (2008)	Internal readiness	The factors in the internal context that are found to affect adoption of e-commerce in supply chains	IT characteristics, organizational characteristics, buying need characteristics	Adoption of e-commerce
Barua et al. (2004)	Supplier readiness	The degree to which a firm's suppliers are willing and ready to conduct business activities electronically	N/A	Supplier-side digitization
Caniëls et al. (2013)	Supplier readiness	Internal characteristics of suppliers, including manager environmental awareness, inter-organizational communication, and the availability of human, technical, and financial resources	Manager environmental awareness, inter-organizational communication, human resources, technical resources, financial resources	Participation in green supply chain initiatives
Chen et al. (2016)	Organizational readiness	The extent to which organizational resources are available for using big data analytics	Capital/financial resources, IT infrastructure, IT human resources	Big data analytics use
Kros et al. (2011)	Technology readiness	A firm's propensity to embrace and use new technologies for accomplishing goals	Technology optimism, technology innovativeness	RFID acceptance
Li et al. (2017)	Organizational preparedness	The infrastructural contexts in an organization that allow it to be capable of sharing knowledge with external partner firms	Internal culture, structure, availability of resources, technological capabilities	ERP implementation effectiveness
Richey et al. (2007)	Technological complementarity	A unique and symmetric strategic combination of firm roles, goals, readiness for implementation, and use of technology across partnering firms and the extended supply chain	Optimism, innovativeness, discomfort, insecurity	Logistics service quality
Rotchanakitumnuai (2013)	Organizational readiness	Organizational readiness in terms of sufficient IT resources and knowledge to use e-procurement	Sufficient IT resources, sufficient knowledge	E-procurement auction
Venkatesh & Bala (2012)	Technology readiness	The degree to which a focal firm has the necessary technology infrastructure and IT human resources to implement inter-organizational business process standards	Technology infrastructure, IT human resources	Inter-organizational business process standards
Wiengarten et al. (2011)	E-business readiness	The degree to which a firm's suppliers are willing and able to conduct business activities electronically (Barua et al., 2004)	N/A	E-business applications

IT human resources refers to the professionals in an organization who have the technological knowledge and skills to implement digital procurement technologies (Chen et al., 2016; Turkulainen and Swink, 2017). The influence of skilled IT human resources is critical because the implementation of advanced digital technologies requires personnel who have an understanding of both technological and process aspects of digital procurement (Rotchanakitumnuai, 2013; Venkatesh and Bala, 2012). Many practitioner studies conclude that digital procurement practices require a very different skill set from procurement managers (Batran et al., 2017; Pellengahr et al., 2016). New job profiles that call for a diverse skill set, such as data scientists, are likely to be required for this transformation of procurement (Schoenherr and Speier-Pero, 2015).

Organizational readiness. *Organizational readiness* has been identified as another key factor in the adoption decision (Bakker et al., 2008; Chen et al., 2016; Sternberg and Norrman, 2017). Organizational readiness has been defined to mean that the organizational resources needed for adoption are already available (Iacovou et al., 1995, p. 467). The term refers to the managerial prerequisites in an organization that allow it to embrace and use new digital technologies in procurement (Li et al., 2017). In this study, we include top management support, financial resources, and organizational structure as the main indicators of organizational readiness.

Top management support denotes the degree to which top managers understand and appreciate the value potential of digital procurement, as well as the degree to which they champion and promote the use of digital technologies and practices in procurement (Chen et al., 2016). The literature widely recognizes that top management support is a critical enabler for strategic procurement initiatives (Li et al., 2017; Paulraj et al., 2012) and for IT use in organizations (Li et al., 2017; Liang et al., 2007; Rotchanakitumnuai, 2013). Top managers can direct financial and personnel resources toward the procurement function (Cousins et al., 2006) and can facilitate changes of organizational norms, values, and cultures (Chen et al., 2016; Li et al., 2017). Likewise, practitioners emphasize the value of top management support for driving the digitalization of procurement practices (Batran et al., 2017; Pellengahr et al., 2016).

Financial resources allow companies to invest in hardware, software, and system integration and thus represent an important factor for technology adoption (Zhu et al., 2004). Prior literature suggests that companies require sufficient financial resources to implement digital technologies (Chen et al., 2016). The availability of needed financial resources can be approximated using measures of firm size and profitability.

Organizational structure comprises the roles, responsibilities, and interfaces for the coordination and integration of digital procurement both in the company and with external partners. Coordination and integration can be achieved through vertical mechanisms (e.g., centralized under a chief digital officer) or through lateral mechanisms (e.g., decentralized across cross-functional teams). Practitioners emphasize that agile teams and dedicated roles (e.g., a digital support team) can provide a needed organizational resource to enable the adoption of digital technologies and practices (Schnellbächer et al., 2018).

Environmental factors. The TOE framework further recognizes that various *environmental factors* influence the use of new technologies (Tornatzky and Fleischer, 1990). Prior studies that have applied the TOE framework in a supply chain context have acknowledged the general relevance of suppliers as an environmental factor, but they have not delved into the actual *interplay* between buying firms and suppliers (Mishra et al., 2007). We discuss supplier-side digital readiness as part of a TOE framework in the next section.

2.4. Supplier-side digital readiness

Because the buyer–supplier dyad is at the core of supply chain management, we introduce a dyadic perspective that explicitly incorporates the supplier as the complementary counterpart to the buying firm.

Both the TOE framework and the SCPV recognize that firms do not operate in isolation but are necessarily interacting with external partners in the supply chain (Carter et al., 2017b; Mishra et al., 2007). To illustrate, in the early phase of e-procurement, General Electric faced difficulties in implementing e-procurement because a significant proportion of its suppliers was not ready to do business online (Barua et al., 2004). Because advanced digital procurement is characterized by relationships *between* companies (Srai and Lorentz, 2019), a company seeking to implement digital technologies today is likely to be influenced by, if not dependent on, the readiness of its suppliers (Bruque-Cámara et al., 2016).

Supplier-side digital readiness is defined as the degree to which a firm's supplier is able to embrace and use digital technologies to engage in digital interactions with customers (Barua et al., 2004; Richey et al., 2007). When suppliers have high digitalization levels, firms can use digital practices across firm boundaries, whereas low digitalization levels can impede efforts to implement inter-organizational digital procurement practices (Agi et al., 2005; Mishra et al., 2007). Lack of supplier-side digital readiness has repeatedly been shown to inhibit digitalization efforts in supply chains (Barua et al., 2004; Mishra et al., 2007; Richey et al., 2007; Wiengarten et al., 2011).

We conceptualize the dimensions of supplier-side digital readiness as *complementary* to digital procurement readiness on the buyer side because the supplier acts as the complementary counterpart to the buying firm in the adoption of inter-organizational practices. Therefore, supplier-side digital readiness also encompasses the dimensions of *technological readiness*, with its sub-dimensions of *IT infrastructure* and *IT human resources*, and organizational readiness, with the sub-dimensions of *top management* support, *financial resources*, and *organizational structure*. To achieve digital complementarity, the supplier should possess similar or comparable degrees of readiness for implementing digital technologies across partnering firms and the extended supply chain (Richey et al., 2007). What complementarity entails for each dimension and sub-dimension of supplier-side digital readiness plays out differently, depending on the digital procurement practice in focus. For example, providing rapid prototyping services via additive manufacturing requires a comprehensive IT infrastructure and experienced IT human resources on the supplier side, while exchanging order information and tracking of orders via cloud-based e-procurement applications requires only relatively basic IT infrastructure and IT human resources on the supplier side.

2.5. Moderating effects

A factor that potentially exerts a key moderating effect on the link between digital procurement readiness and digital procurement practices is the *relationship type*. Extant literature has shown that buyer–supplier relationships can be either transactional or collaborative in nature (e.g., Chicksand et al., 2016; Kaufmann et al., 2018). *Transactional* relationships are characterized by a relatively basic exchange of information, products, and services (Heide and John, 1992), and by a general uncertainty about the continuity and time horizon of future interaction (Williamson, 2008). *Collaborative* relationships are characterized by cooperation for mutual gain (Williamson, 2008), a norm of information exchange (Heide and John, 1992), and trust (Ta et al., 2018). Trust refers to an exchange partner's expectation that the other party can be relied on and will act fairly (Poppo et al., 2016; Ta et al., 2018). The relationship type (i.e., transactional or collaborative) can moderate the readiness–practice link in two ways. First, the relationship type can influence the decision about which digital procurement practices a buying company aims to adopt for a particular buyer–supplier relationship. For example, e-auctions and electronic marketplaces appear suitable for transactional relationships, whereas the integration

of supply chain partners into an industrial cloud (e.g., for production planning and inventory management) appears more suitable for collaborative relationships. Second, the relationship type can moderate the adoption process of a selected digital procurement practice because it influences transaction costs, as well as bilateral coordination and knowledge exchange (Wang et al., 2016). Moreover, a lack of trust in the relationship might make firms hesitant to implement technologies that give higher transparency to their supply chain partner.

According to the TOE framework (Tornatzky and Fleischer, 1990), the adoption of digital technologies can be further moderated by various environmental factors, such as the competitive landscape (Chen et al., 2016) and the institutional context (Bhakoo and Choi, 2013). The institutional context describes the political, social, and market environment in which a company is embedded. It encompasses a wide range of factors, such as data protection regulations, attitudes toward new technology adoption, IT expertise in the labor force, and Internet connection speed. In this study, we focus on the *institutional context* as a moderator on the readiness–practice link because it has been found to inhibit the implementation of supply chain technologies in contexts such as emerging markets (Saldanha et al., 2015).

Furthermore, various factors might exert a moderating or mediating effect on the link between digital procurement practices and performance. For example, Bruque-Cámara et al. (2016) analyzed the potential mediating effects of physical and informational supply chain integration on the link between community cloud implementation and operational results. As indicated by the relevant arrow in Fig. 1, digital procurement readiness also might function as a moderator of the relationship between digital procurement practices and performance. To illustrate, RFID tracking in the supply chain might influence inventory costs, and this link might be moderated by the level of the supplier's IT infrastructure: The more advanced the infrastructure, the more accurately the system will function and the lower the inventory costs can be.

2.6. Performance

The SCPV further emphasizes *performance* as the dependent variable, rather than sustained competitive advantage, as in the resource-based or relational view. This emphasis implies that "the SCPV is not exclusively concerned with explaining the performance of the few supply chain leaders at the top of an industry, but is mainly interested in understanding performance variation among the vast majority of the remaining supply chain dyads or networks" (Carter et al., 2017b, pp. 116–117). Regarding the performance outcomes, the SCPV allows for a range of intermediate and final dependent variables (Bromiley and Rau, 2016). Intermediate outcomes in digital procurement might be the cycle time for processing purchase orders or savings on purchase costs, while a final outcome could be the return on supply management assets (ROSMA) (Blascovich et al., 2016). Furthermore, the SCPV differentiates between individual and relational performance. *Individual performance* results from the use of intra-organizational practices or from the interaction of intra- and inter-organizational practices (Carter et al., 2017b). *Relational performance* refers to "performance benefits mutually generated by two or more organizations that cannot be generated by any one of those organizations" (Carter et al., 2017b, p. 116). Relational performance appears particularly relevant for a PSM context, where value to a large extent is created along the entire supply chain.

Because of the nascent stage of the field, most studies are only beginning to explore the effects of *advanced* digital technologies on PSM (e.g., Durach et al., 2017b; Kache and Seuring, 2017). For example, Bruque-Cámara et al. (2016) have assessed the effects of cloud computing on operational performance in terms of flexibility and delivery performance (Bruque-Cámara et al., 2016). Anecdotal evidence indicates that leading companies that use digital technologies – for example, IBM Watson's use of artificial intelligence or SAP Ariba's procure-to-pay solution – have achieved significant performance improvements in procurement, including more efficient operations, a smaller carbon footprint, and substantial cost reductions (McGee, 2018).

However, researchers caution that "empirical evidence about the more advanced forms of practical implementation in PSM is yet to be collected on a large scale; hence, it is difficult to draw conclusions about PSM digitalization-related performance associations or even causalities" (Srai and Lorentz, 2019, p. 1). The SCPV can function as a theoretical lens to systematically investigate the link between digital procurement practices and performance; it can help to explain digital procurement's effects both on individual performance (regarding efficiency and effectiveness) and on the performance of supply chain dyads or networks. Methodologically, research questions associated with the performance outcomes of digital procurement practices can most reliably be measured via large-N quantitative studies. Because an empirical assessment of the practice–performance link is beyond the scope of the present study, we join Srai and Lorentz (2019) in their call for future research to collect large-scale empirical evidence on the performance outcomes of digital procurement practices.

In the following, we present the methodology of our empirical case studies, which focus on the readiness–practice link; the intermediate outcome we examined is whether the practice had been *adopted* or not.

3. Methodology

To help answer our first research question of how digital readiness influences the implementation of digital procurement practices and to corroborate the findings from the literature review with first empirical data, we conducted explanatory case studies of buyer–supplier dyads (Dubois and Salmi, 2016; Ketokivi and Choi, 2014). The dyadic case studies involve two Western European buying firms and six of their key suppliers in Europe and China. We have modified the names of these companies to maintain confidentiality. The unit of analysis is the buyer–supplier relationship.

3.1. Selection of cases

In selecting cases, we followed the theoretical sampling principle under which cases are chosen for their potential to illuminate and extend relationships and logic among constructs (Corbin and Strauss, 2008; Eisenhardt and Graebner, 2007). The selected buying companies, IndustryCo and AutoseatsCo, represent leaders in their respective industries. IndustryCo is a true positive outlier (Makino and Chan, 2017) in the digital transformation of industry, and the Chinese manufacturing site selected for this case study is recognized as a model "digital factory." China was selected as a particularly information-rich research context (Dubois and Salmi, 2016) because the Chinese supply market has high empirical relevance (Kosmol et al., 2018) and is currently undergoing digital transformation at a very rapid pace. Given IndustryCo's leading position in digital manufacturing technologies, its top executives have demonstrated a strong commitment to implementing digital procurement in the firm's Chinese model factory; they also have shown strong support for this research effort. IndustryCo's factory manager explained the overall digitalization strategy:

> *With "Made in China (2025)," the Chinese government is really pushing for Industry 4.0 in order to go away from the cheap factory of the world to a more advanced factory in China. We as IndustryCo really want to be a part of this transition. We think with our digitalization that we have here in our factory, we are clearly one of the most advanced factories in China.* (Factory Manager, IndustryCo).

In line with the theoretical sampling principle, and based on emergent findings from the IndustryCo cases, we also selected a representative case to enhance the generalizability of our findings (Eisenhardt and Graebner, 2007). AutoseatsCo represents the broader group of companies that struggle in realizing the full potential of digital

procurement. AutoseatsCo is a leading automotive seating manufacturer that embraced digital transformation early on by establishing a Digital Office and by implementing an organization-wide digital transformation program. However, the company has faced challenges in implementing its ambitious roadmap for digital procurement.

A high ratio of purchasing spend to sales indicates that both IndustryCo and AutoseatsCo depend greatly on their supply base. Consequently, suppliers play a critical role in enabling the success of these companies. Following the theoretical sampling principle, we selected the six key suppliers for the case studies to enhance external validity and generalizability (Eisenhardt and Graebner, 2007; Flyvbjerg, 2006). We asked a senior procurement manager at each buying firm to identify key suppliers with which the company had either successfully implemented digitalization projects or encountered difficulties in implementing digitalization projects (i.e., to identify polar cases) (Eisenhardt and Graebner, 2007). Therefore, the selection criterion for the polar cases was whether the practice had been *adopted* at all, and not what the performance outcomes of the digital procurement practice were. IndustryCo provided two positive cases and two negative cases regarding the adoption or use of digital procurement practices, and AutoseatsCo provided one positive case and one negative case. Table 2 provides summary information on these six dyadic relationships and the companies involved.

3.2. Data collection

Data were collected through 18 in-depth, semi-structured interviews with IndustryCo, AutoseatsCo, and the suppliers, supplemented by documents and onsite visits. Our semi-structured interviews ranged from 20 to 195 min in duration, with an average of 67 min, and they were conducted face-to-face, except for three phone interviews. The interviews were carried out in English or Chinese, depending on the interviewee's preference. All interviews were recorded and transcribed verbatim or were translated as necessary (i.e., from Chinese to English). The informants in the buying firms represented multiple functions and levels of management to ensure construct validity through triangulation (Jick, 1979; Stuart et al., 2002). Their titles included factory manager, head of strategic procurement, operational purchaser, and IT manager. Informant job titles at the suppliers included general manager or key account manager. Appendix B provides further details on the informants.

The semi-structured interview guideline (see Appendix C) was developed from the extant literature on digital procurement and included open-ended questions to enable managers to describe events and processes. It included questions about the organization and digitalization strategy, digitalization initiatives, and barriers to and enablers of digitalization. To complement the interview data and obtain a more complete understanding of the suppliers' digital readiness, we toured their production facilities; we also participated in demonstrations of the digital technologies used at IndustryCo and two of its suppliers. In addition, we collected both publicly available documents (e.g., industry reports and annual reports) and company-internal documents (e.g., project presentations and status reports) from the case companies for the purpose of data triangulation (Pettigrew, 1990).

3.3. Data analysis

For the within-case analysis, we constructed case study reports for each buyer–supplier dyad to extract a rich picture of the digital readiness of the respective firms, as well as barriers and enablers encountered during digitalization initiatives. In the case study reports, we used citations from interviews, photos, and other collected documents to stay close to the original data and to achieve high levels of accuracy (Yin, 2014). To ensure the reliability of our data, we asked the key informants to review the drafts of our case study reports. We then began the within-case analysis of each buyer–supplier dyad, the unit of analysis; we searched for emerging themes and developed a rough theoretical explanation for the adoption of digital procurement practices that fit each dyad. For example, top management support was a concept that emerged in this analysis phase.

For the cross-case analysis, the findings from the within-case analyses were compared to identify similarities and differences among the six dyadic cases (Eisenhardt, 1989; Miles et al., 2013). We coded the cases into constructs that emerged through the comparisons and used this data to develop a series of tables and graphs (Miles et al., 2013). We also compared and contrasted the emerging empirical patterns with the extant literature on digital procurement to further enhance internal and external validity (Gibbert et al., 2008). In the next section, we synthesize our findings on digital procurement readiness from the within-case analysis.

4. Within-case analysis

4.1. IndustryCo

The selected manufacturing site of IndustryCo, a global industrial company, is a state-of-the-art model factory for industrial automation products in China. Despite the high level of automation within its own factory, IndustryCo still had a long way to go to fully establish a digitally integrated supply chain. To automate the purchase-to-pay process, IndustryCo had implemented e-procurement software and was in the process of establishing either classic electronic data interchange (EDI) or WebEDI integration with several of its key suppliers in China, thus enabling an end-to-end digital supply chain.

We must make sure that the information from our customers goes

Table 2
Overview of case study companies.

Company[a]	Head-quarters	Revenues (USD)	# Employees	Length of BSR in years	Case type	Informant job title(s)	# Informants
IndustryCo[b]	Western Europe	120 million	500	N/A	Outlier	Factory Manager, Head of Strategic Procurement, Head of Operational Purchasing, Operational Purchaser, IT Manager	10
Electronics-SPL	China	180 million	9500	5	Negative	Key Account Manager	1
Packaging-SPL	China	1 million	45	5	Negative	General Manager	1
Plastics-SPL	China	20 million	250	2	Positive	Marketing Director	1
Semicon-SPL[c]	United States	13 billion	30,000	5	Positive	Key Account Manager	1
AutoseatsCo	Western Europe	15 billion	75,000	N/A	Representative	Manager Purchasing Process, Director Supplier Risk Management	2
Fasteners-SPL	Spain	30 million	200	25	Negative	Commercial Manager	1
Stampings-SPL	Great Britain	250 million	2000	13	Positive	Senior Commercial Manager	1

[a] Real names are concealed for confidentiality.
[b] Figures relate to the Chinese factory of IndustryCo.
[c] Figures relate to Semicon-SPL globally; IndustryCo sources from its local Chinese subsidiary.

through the whole supply chain quickly, and in real time. It must be a very efficient information transfer if we want to make sure that our whole supply chain responds very quickly. We expect suppliers to have the capability and willingness to cooperate with us—for example, on EDI solutions, the forecast, VMI [vendor-managed inventory]. All these tools aim to make sure that all the information from our customers to our supply chain can move very fast. (Head of Strategic Procurement, IndustryCo).

Although IndustryCo followed an ambitious road map for establishing EDI with most of its suppliers, this project remained a work-in-progress for many of the supplier relationships and constituted one of the largest digitalization projects in the procurement department. As we explain, the difficulties that IndustryCo faced in implementing digital practices with its suppliers, despite its own advanced abilities, well illustrate the importance of a dyadic perspective on digital procurement readiness.

Analyzing IndustryCo through the perspective of the SCPV, we found that the firm's *organizational readiness* was high. IndustryCo's factory manager emphasized the strategic importance of digitalizing its supply chain relationships: *"Procurement is clearly playing an important role [in the digital transformation of IndustryCo] by bringing digitalization to the suppliers"* (Factory Manager, IndustryCo). Similarly, the Head of Strategic Procurement stressed the strong top management support for digital integration with its suppliers:

At IndustryCo, we have high attention, on the one hand, to drive ourselves to use the digitalization tools—for example, data exchange between us and the supplier. We also, on the other hand, encourage our suppliers to invest in these digitalization solutions to make sure that the two companies can exchange information very quickly. In general, our procurement strategy for digitalization is trying to digitalize the manual work and make sure that the information is more efficient. This is the direction we want to drive by using a lot of tools, internally and externally. (Head of Strategic Procurement, IndustryCo).

In terms of financial resources, IndustryCo was in a strong financial position to invest in digitalization. The large industrial company – listed on the stock exchange – had a very good credit rating, and the selected manufacturing site earned high BIT margins over the previous two years. Regarding organizational structure, IndustryCo had installed a chief digital officer at the business unit level and was planning to establish a dedicated responsibility for digitalization in the procurement function:

During a town hall meeting, we recently discussed what we understand by digitalization.… We are now planning to have a procurement employee who dedicates part of her work time to digitalization and who can coordinate digitalization initiatives in procurement. (Head of Operational Purchasing, IndustryCo, follow-up call).

The *technological readiness* of IndustryCo can be categorized as high as well. In terms of IT infrastructure, IndustryCo used a globally integrated ERP system and a company-wide data warehouse that provided transparency on supplier data. Furthermore, IndustryCo employed sophisticated IT experts and dedicated teams that constantly upgraded digital procurement technologies on both the corporate level and the plant level, including EDI. From the perspective of the IT Manager at IndustryCo's Chinese plant, EDI represents *"a standard technology that has been around for a long time"* (IT Manager, IndustryCo), even though many Chinese suppliers encountered difficulties in implementing this technology.

4.2. Supply relationship between IndustryCo and Electronics-SPL (negative case)

Electronics-SPL has been IndustryCo's main supplier of printed circuit boards (PCBs) in China for several years, accounting for the majority of spend in this strategically important purchase category. In turn, Electronics-SPL viewed IndustryCo as a strategic partner and ranked it among its top five customers globally. The buyer–supplier relationship can be characterized as *collaborative*, which implies that IndustryCo had targeted a deeper digital integration with Electronics-SPL. In 2014 both companies had initiated a joint project to implement EDI for streamlining the order process. However, during the implementation process, the companies encountered problems with the data exchange (e.g., wrongly duplicated purchase orders and difficulties in making order changes), so that they stopped using the EDI link. Although this negative event certainly reduced both companies' motivation to tackle the EDI implementation, we found a key underlying root cause of the implementation challenges was Electronics-SPL's low to medium level of digital procurement readiness.

The Operational Purchaser described Electronics-SPL as *"a very professional supplier"* that *"knows the benefits of EDI"* and that was willing to adopt the technology. As a medium-sized company that had earned strong EBIT margins over the previous two years, Electronics-SPL also had sufficient financial resources to invest in digitalization. However, the supplier lacked the support from top management that was required to successfully implement this digital technology. Electronics-SPL's Key Account Manager explained:

Why is our attention toward IT not developed? This depends on where the boss puts his emphasis with regards to the company's development. For example, because labor costs might be too cheap, the boss does not want to invest a lot of money in an IT system. So this concept of EDI first needs to get into the heart of the boss. (Key Account Manager, Electronics-SPL).

In terms of *technological readiness*, Electronics-SPL can be categorized as low. The supplier used an ERP system that had been developed in-house, rather than buying one from an external provider *"because up to now our boss has been more focused on the sales products"* (Key Account Manager, Electronics-SPL). This homegrown ERP system showed poor compatibility with external interfaces, which meant that IndustryCo was linked to Electronics-SPL via a third-party EDI platform rather than directly. Furthermore, Electronics-SPL had to export the daily order information from the third-party platform using Excel and then manually transfer it to its ERP system because the system had no Excel upload functionality. This lack of an adequate IT infrastructure severely impeded the implementation of EDI, as IndustryCo's Operational Purchaser described:

For EDI, most importantly, the supplier first needs to possess the ERP system himself. If the supplier himself does not possess a system that allows for EDI, there is no way to implement EDI. The supplier needs to be system-ready. (Operational Purchaser, IndustryCo).

In addition to the poor IT infrastructure, a lack of skilled IT human resources at Electronics-SPL hampered the implementation of EDI, as the Key Account Manager explained:

EDI requires quite grown-up IT engineering skills, it needs a very grown-up technology team. It depends on the company's degree of attention towards IT. So if our IT department is not so developed, the risks associated with EDI can be very big. If they do not understand the EDI system, this can turn into a disaster. (Key Account Manager, Electronics-SPL).

As a consequence, Electronics-SPL represented a clear bottleneck for IndustryCo's efforts to establish a digitally integrated supply chain. Because the supply chain partners had to revert to exchanging order data via email, they were not able to realize joint improvements in efficiency:

With the current solution via email, we need to spend more time. We would wish that we can use EDI with IndustryCo. This would increase efficiency. (Key Account Manager, Electronics-SPL).

4.3. Supply relationship between IndustryCo and Packaging-SPL (negative case)

Packaging-SPL was a small manufacturer of cardboard boxes that accounted for the majority of IndustryCo's purchase volume in this category, and IndustryCo was the number one customer for Packaging-SPL. Given the relatively basic exchange of products and the fact that the supplier could be replaced relatively easily, the buyer–supplier relationship is characterized as *transactional*. The transactional nature of the relationship implied that IndustryCo primarily aimed to implement digital procurement practices that would reduce the transaction costs through more efficient information transfer. To reduce the lead time and inventory for cardboard boxes, IndustryCo shared the daily production forecast with Packaging-SPL via an Internet platform. However, purchase orders still were transferred to Packaging-SPL via email in an Excel file because the supplier balked at the adoption of IndustryCo's WebEDI solution.

The *organizational readiness* of Packaging-SPL is categorized as low. The site visit revealed that this small, privately owned supplier so far had only a basic organizational structure and simple operational processes in place. Although no financial data was available for Packaging-SPL, the on-site visit revealed a high degree of manual processing in production and only very limited investments in machinery. Compared with other packaging suppliers in the industry, these findings indicated that Packaging-SPL had only limited financial resources and operated on relatively low profit margins. Although Packaging-SPL's manager showed *"strong willingness to cooperate"* (Operational Purchaser, IndustryCo) with IndustryCo on the solution for accessing the daily production forecast via the Internet platform, it was not yet willing to adopt the WebEDI solution to exchange order data. According to IndustryCo's Operational Purchaser, this WebEDI solution was not viewed as beneficial by the supplier because it required additional manual data processing on the supplier's side.

The *technological readiness* of Packaging-SPL also is categorized as low. According to IndustryCo's Operational Purchaser, the supplier's *"IT support is very poor,"* which impeded the joint implementation of digital technologies like EDI:

> *The reason why we did not implement EDI [with Packaging-SPL] lies mainly at the supplier side because its employees cannot handle our data very efficiently if we send the EDI data to them. So we would have to teach them how to understand our EDI data. They replied to us that they hoped to choose the traditional method to handle our purchase orders, by Excel and by email communication.* (Operational Purchaser, IndustryCo).

Because of Packaging-SPL's low technological readiness, the WebEDI solution could not be successfully implemented, and the order data were still exchanged via phone and email. Internal status presentations from IndustryCo showed that poor *"supplier EDI capability"* and insufficient *"supplier IT resources"* posed a serious constraint to realizing IndustryCo's road map for establishing comprehensive EDI. As a consequence, the roadmap needed to be *"adjusted to the business environment"* (internal company presentation) in the Chinese supply market, and the implementation of more advanced digital procurement technologies had to be postponed.

4.4. Supply relationship between IndustryCo and Plastics-SPL (positive case)

Plastics-SPL is a manufacturer of plastic injection parts that had been working with IndustryCo for about two years. Although IndustryCo's current order volumes were still low, the supplier showed *"a strong desire"* to expand its business with IndustryCo (Operational Purchaser, IndustryCo). Because some uncertainty about the future trajectory of the business remained, the current buyer–supplier relationship was characterized as *transactional*. Nevertheless, both companies were willing to take a 'leap of faith' (Chicksand et al., 2016) and aimed for a deeper digital integration to move toward a collaborative relationship. Plastics-SPL did not even have an ERP system until 2016, but IndustryCo's implementation of the WebEDI solution with Plastics-SPL went very smoothly and had significantly reduced IndustryCo's workload for purchase orders.

The *organizational readiness* of Plastics-SPL was categorized as medium to high. Plastics-SPL described itself as a modern enterprise with a focus on *"constant innovation"* for *"the Industry 4.0 era."* The onsite visit revealed that Plastics-SPL had recently invested in a new production facility and modern manufacturing equipment. This investment suggested to us that the financial resources of Plastics-SPL could be categorized as medium, despite its relatively small size of 250 employees and revenues of 20 million Euros. IndustryCo's Operational Purchaser explained that Plastics-SPL's *"internal management processes are very good"* and that a dedicated order management team facilitated the adoption of the WebEDI solution. A key factor for the successful implementation of WebEDI was the willingness of Plastics-SPL's top management to strengthen the business relationship with IndustryCo:

> *We are a digital factory; we require suppliers to use EDI. We also consider this when we assign future orders.… Plastics-SPL is a new supplier that has a strong willingness to do business with us, so it is easier to implement EDI with this supplier compared with other suppliers.* (Operational Purchaser, IndustryCo).

The *technological readiness* of Plastics-SPL also can be categorized as medium. In terms of IT infrastructure, Plastics-SPL had recently introduced an ERP system from an Asian software provider that allowed for the internal processing of order data, but it impeded the external integration with IndustryCo's WebEDI solution.

> *It is a very specialized ERP system in the molding industry. The external interfaces are not quite the same, so there is no way to directly interface with IndustryCo. […] When implementing WebEDI, we had a lot of communication with IndustryCo, but we could not manage to directly transfer an order to our ERP system.* (Marketing Director, Plastics-SPL).

Despite the initial interface problems, Plastics-SPL acquired the necessary technological knowledge and skills to implement the WebEDI solution. Plastics-SPL's WebEDI experience with other customers was especially helpful in facilitating the adoption:

> *What was very good was that the supplier already had experience with WebEDI. They already had this experience from other customers and were very willing to do it this way with IndustryCo.* (Operational Purchaser, IndustryCo).

4.5. Supply relationship between IndustryCo and Semicon-SPL (positive case)

Semicon-SPL is a global manufacturer of semiconductors. The firm ranked among IndustryCo's top three suppliers. IndustryCo accounted for only a small share of Semicon-SPL's revenues, but it was valued as a key customer because of its leading role in the digital transformation of industry. The relationship between Semicon-SPL and IndustryCo was based on *"mutual trust"* (Key Account Manager, Semicon-SPL), and we characterized it as *collaborative*. Both parties saw a deep digital integration as a means for joint improvements and as a natural trajectory in this buyer–supplier relationship.

The *organizational readiness* of Semicon-SPL was categorized as high. Semicon-SPL described itself as an *"advocate of Industry 4.0"* and was committed to driving digitalization (Key Account Manager, Semicon-SPL). The Key Account Manager explained that Semicon-SPL required its business partners – and especially key customers such as IndustryCo – to implement EDI to reduce the workload:

We have a lot of business with IndustryCo worldwide so far. We will have more and more business with IndustryCo and grow with IndustryCo, so this is the reason why we implemented the EDI: to facilitate the procurement and manufacturing. (Key Account Manager, Semicon-SPL).

As a stock-listed company, Semicon-SPL had ample financial resources to invest in digitalization; it had good credit ratings and very high two-digit EBIT margins over the past two years. Furthermore, Semicon-SPL maintained a dedicated team in the IT department that was responsible for the implementation of digital technologies with its business partners, and this team facilitated the implementation of EDI with IndustryCo.

The *technological readiness* of Semicon-SPL also was categorized as high. Semicon-SPL used the same ERP system as IndustryCo, which was viewed as an enabler for the EDI implementation because it largely eliminated interface problems. Although Semicon-SPL's IT resources were in high demand, the company had sufficient experience in EDI implementation and had access to highly qualified IT experts.

Semicon-SPL already started using EDI technology very early, so they probably understand this technology quite well. (Operational Purchaser, IndustryCo).

Semicon's Key Account Manager also emphasized the critical role that IT human resources played in the successful implementation of EDI:

I think the EDI implementation is dependent on the IT team's capability. If the IT is very genius and does not have an issue with the different ERP systems, then the implementation is quite fast, smooth, and safe and stable. (Key Account Manager, Semicon-SPL).

4.6. AutoseatsCo

AutoseatsCo is a global automotive seating manufacturer. It has pursued several digitalization initiatives in procurement across its sites. For example, to replace its legacy solutions, it has begun rolling out an e-procurement suite that includes functionalities such as e-RfX, e-Auctions, catalog buying, and contract management. Furthermore, AutoseatsCo was in the process of implementing an advanced digital should-cost tool to replace conventional cost breakdowns and to analyze a purchase item's underlying cost structure. *"Our should-cost tool calculates the cost for the 'perfect plant,' and then we compare this with the costs of our suppliers. […] Then we see where the gaps are, and we try to close these gaps in a joint project"* (Manager Purchasing Process, AutoseatsCo). Our analysis focused on the implementation of this advanced digital should-cost tool because AutoseatsCo repeatedly emphasized the uniqueness of this solution; and yet, the challenges in the implementation process were representative of its digitalization efforts.

Applying the analytical lens of the SCPV, we ranked the *organizational readiness* of AutoseatsCo as medium to high. The leadership team showed *"unwavering support"* for digital procurement and was pursuing an ambitious roadmap for digital procurement. Still, AutoseatsCo lacked the needed financial resources for implementing digital technologies throughout the organization:

We have a strategy, a five-year plan. But I am not sure if we can realize this plan because we have a problem with the budget. (Manager Purchasing Process, AutoseatsCo).

AutoseatsCo's tight financial resources were reflected in low and even negative EBIT margins during the past two years. Regarding the rollout of an integrated ERP system, the Director Supplier Risk Management also emphasized the financial constraints:

We have this rollout plan, but this would have to be backed with real money. But since you have to show the stock market how profitable the company is, no money will be released. (Director Supplier Risk Management, AutoseatsCo).

Although AutoseatsCo had established a Digital Office at the corporate level, no dedicated position for digital procurement existed yet. Instead, AutoseatsCo was using cross-functional project teams to run digitalization projects, such as the rollout of the new e-procurement suite.

The *technological readiness* of AutoseatsCo was set at medium to high as well. Establishing an integrated ERP system was the main challenge. Because the company had grown through acquisitions, the IT infrastructure comprised several ERP systems that lacked integration.

We have over twenty different ERP systems in use that don't talk to each other. […] Before we talk about digitalization, maybe we should get a reasonable SAP rollout done. […] We have approaches for digital procurement, but we lack the infrastructure on our side. (Director Supplier Risk Management, AutoseatsCo).

The rather fragmented ERP system landscape resulted in additional manual data processing efforts, limited the transparency of supplier data, and complicated the rollout of digital technologies, such as the new e-procurement suite. Regarding IT human resources, the Manager Purchasing Process noted that *"people with deep knowledge are key for digital procurement"* and that AutoseatsCo had great SAP experts on its team for the rollout of the new e-procurement suite. The high potential of the company's human resources currently seemed to be held back by the issues in funding and organizational structure.

4.7. Supply relationship between AutoseatsCo and Fasteners-SPL (negative case)

Fasteners-SPL is a medium-sized supplier of nuts and bolts for the automotive industry and represented a C-supplier for AutoseatsCo. From the supplier's perspective, though, AutoseatsCo was Fastener-SPL's number one customer. Based on the relatively basic exchange of products and a perceived lack of trust, the buyer–supplier relationship was characterized as *transactional*.

The *organizational readiness* of Fasteners-SPL was categorized as low. The medium-sized company's ability to invest in digitalization was constrained by limited financial resources and low EBIT margins. AutoseatsCo had been preparing for more than a year to implement its advanced digital should-cost tool with Fasteners-SPL, but the implementation was delayed because the supplier was not interested in adopting this digital technology.

We are not interested in this should-cost tool because it is only suitable for simple parts, and we are specialized on complex parts. It would be perfect for us if AutoseatsCo does not implement this system. (Commercial Manager, Fasteners-SPL).

The supplier was worried that the price benchmark comparisons were not applicable to its cost structure and that the advanced digital should-cost tool would be used by AutoseatsCo to negotiate lower prices. AutoseatsCo's Manager Purchasing Process acknowledged that the higher transparency through the should-cost tool might reduce the supplier's margins, but he also emphasized the benefits for the supplier, in that *"using the should-cost tool is an advantage for receiving contracts."*

The *technological readiness* of Fasteners-SPL was evaluated as low to medium. Fastener-SPL's Commercial Manager stated that its IT systems already fulfill the requirements of its customers and that Fasteners-SPL possessed sufficient IT expertise. As AutoseatsCo's Manager Purchasing Process acknowledged, the factor that restrained the firm's implementation of the advanced digital should-cost tool was not technological but organizational:

Some suppliers do not like to implement the should-cost tool because they have to show us everything. (Manager Purchasing Process, AutoseatsCo).

Table 3
Case analysis display of digital readiness.

	Organizational readiness			Technological readiness		
Company	Top management support	Financial resources	Organizational structure	IT infrastructure	IT human resources	Overall digital readiness
IndustryCo	high	high	medium	high	high	high
Electronics-SPL	low	high	medium	low	low	low-medium
Packaging-SPL	low	low	low	low	low	low
Plastics-SPL	high	medium	medium	medium	low	medium
Semicon-SPL	high	high	medium	high	high	high
AutoseatsCo	high	low	medium	medium	high	medium-high
Fasteners-SPL	low	low	low	low	low	low
Stampings-SPL	medium	medium	medium	low	low	low-medium

4.8. Supply relationship between AutoseatsCo and Stampings-SPL (positive case)

Stampings-SPL manufactures precision stamped parts across several locations in Europe. AutoseatsCo was among its most important customers, while Stampings-SPL represented a B-supplier to AutoseatsCo. The buyer–supplier relationship was characterized as *transactional* because the supplied products were relatively basic and the supplier switching costs comparatively low. Both companies successfully implemented the advanced digital should-cost tool about one year ago. Stampings-SPL's Senior Commercial Manager viewed *"a basis of trust as a prerequisite"* for the implementation, especially because the tool offered no transparency showing how its complex algorithms calculated the benchmark prices. As a result of the implementation, Stampings-SPL committed to significant price reductions for its current products and agreed on a lower cost basis for future products, but it also strengthened its position as a preferred supplier.

The *organizational readiness* of Stampings-SPL was categorized as medium. With revenues of 250 million Euros and high single-digit but decreasing EBIT margins, Stampings-SPL's financial resources for investing in digitalization was categorized as medium. The Senior Commercial Manager stated that Stampings-SPL does not proactively invest in digitalization but needs to *"keep up with the requirements of the customers"* (Senior Commercial Manager, Stampings-SPL). To keep pace with increasing customer demands, the supplier's top management regularly invested in advanced manufacturing technology:

> *"Growth doesn't come with backward-thinking manufacturing techniques or methods."* (Managing Director, Stampings-SPL).

Because AutoseatsCo was one of its most important customers, Stampings-SPL decided to implement the advanced digital should-cost tool, although its Senior Commercial Manager recognized that the increased transparency mainly served the customer's interest:

> *Basically, we were open to the introduction of the should-cost tool. On the one hand, the should-cost tool enables us to work transparently with AutoseatsCo. […] That the customer requires transparency is a completely normal process in the automotive industry. […] On the other hand, we know that the customer has a certain expectation and that behind the should-cost tool is a cost-cutting program.* (Senior Commercial Manager, Stampings-SPL).

A key prerequisite for the successful implementation of the advanced digital should-cost tool was that the supplier could assert its commercial interests in the negotiations during the implementation process:

> *We have been negotiating the input parameters into the should-cost tool for a very long time. […] We had to make sure that what came out of the should-cost tool in the end was comprehensible to us and that the prices were acceptable for the future.* (Senior Commercial Manager, Stampings-SPL).

The *technological readiness* of Stampings-SPL was categorized as low. After Stampings-SPL's acquisition two years ago, the IT infrastructure of the newly combined companies had not yet been integrated. Although an internal IT department managed the IT infrastructure at Stampings-SPL headquarters, the IT function of the acquired company was outsourced to an external service provider. The Senior Commercial Manager explained that the IT infrastructure of Stampings-SPL was outdated, noting that its IT equipment had to be upgraded with larger storage to implement the should-cost tool.

> *Our IT is not very advanced because we have always managed to get by with the available [systems]. Other suppliers are certainly better in this regard.* (Senior Commercial Manager, Stampings-SPL).

However, because the advanced digital should-cost tool did not place high technology requirements on the supplier, the current level of IT infrastructure was sufficient to implement the tool. This case illustrates particularly well the importance of the dyadic perspective of digital procurement readiness: A fit between the aspirations and abilities of the buying firm and the supplier is a prerequisite for successful implementation of digital procurement practices.

5. Cross-case analysis

The within-case analysis discussed in the previous section looks at the digital readiness within each dyad. Here, we conduct our analysis across the six buyer–supplier dyads, based on the case analysis shown in Table 3 and Table 4. Our goal is to gain an in-depth understanding of the interplay of buyers and suppliers in the implementation of digital technologies.

We first synthesize overarching patterns of digital readiness across the eight case companies before exploring dynamic change processes in the discussion section. The first general finding pertains to the firms' use of only *relatively mature digital technologies*. The case companies had implemented only basic digital technologies at the time of data collection, despite their leading industry positions and ambitious digitalization roadmaps. We did not find evidence that advanced digital technologies (e.g., big data analytics, blockchain) were being implemented at the case companies, which again suggests that the vast majority of firms still have a long way to go on their digitalization journey. Bottlenecks on the supplier side might be one factor that hinders buying firms from implementing more advanced inter-organizational digital procurement practices.

The results of the within-case analysis empirically support the theoretically derived dimensions and sub-dimensions of digital

Table 4
Case analysis display of moderating effects.

Buyer-supplier dyad	Institutional context	Relationship type
IndustryCo - Electronics-SPL	emerging market	collaborative
IndustryCo - Packaging-SPL	emerging market	transactional
IndustryCo - Plastics-SPL	emerging market	transactional
IndustryCo - Semicon-SPL	emerging market	collaborative
AutoseatsCo - Fasteners-SPL	developed market	transactional
AutoseatsCo - Stampings-SPL	developed market	transactional

procurement readiness as relevant factors for explaining the adoption of digital technologies in procurement. High *organizational readiness* seems to play an enabling role for the adoption of digital technologies, although the causal mechanisms at play might differ for each of the sub-dimensions: top management support, financial resources, and organizational structure. Financial resources seem to be a necessary but not sufficient condition for companies to embrace new digital technologies in procurement. In the case of AutoseatsCo, tight financial resources constrained the implementation of the company's digitalization roadmap, while in the case of Electronics-SPL, sufficient financial resources alone did not result in the successful adoption of digital technologies. The cases suggest that top management support and organizational structure are needed as critical ingredients for the adoption of digital technologies. Meanwhile, low *technological readiness* seems to impede the adoption of digital technologies; low levels of both IT infrastructure and IT human resources were associated with unsuccessful technology adoption in the negative cases of Electronics-SPL, Packaging-SPL, and Fasteners-SPL. For example, in the case of Packaging-SPL, the employees displayed less than adequate technology competencies for dealing with the EDI technology.

Analyzing the moderating role of the *institutional context* – that is, whether the buyer–supplier relationship is embedded in an emerging or developed market context – provides interesting insights. Especially in the institutional context in which IndustryCo's Chinese manufacturing site operates, the fragmented ERP landscape presented a barrier to digital integration with suppliers. As such, our findings provide support for the relevance of the *environmental dimension* of the TOE framework. The interoperability of ERP systems was cited as a barrier for all three cases where IndustryCo cooperated with local Chinese suppliers (Electronics-SPL, Packaging-SPL, Plastics-SPL), reflecting the challenges presented by the fragmented ERP landscape in China (Li et al., 2017). A comparison of EDI implementation ratios between IndustryCo's Chinese manufacturing site and its almost identical sister plant in Western Europe underscores the strong influence of the institutional context: IndustryCo's Western European plant had achieved 100% EDI integration with its suppliers, but IndustryCo's Chinese plant had reached only 47% EDI coverage (based on purchase volume) at the time of data collection. An internal presentation of IndustryCo's Chinese manufacturing site stated that *"the [EDI implementation] road map is adjusted to the business environment."* Therefore, we propose that the institutional context moderates the link between digital procurement readiness and digital procurement practices.

The cross-case analysis on the moderating role of *relationship type* – that is, whether the buyer–supplier relationship is more transactional or collaborative in nature – does not suggest that the relationship type in itself has a universal moderating effect. Of the two negative cases involving IndustryCo (Electronics-SPL, Packaging-SPL), one had a collaborative relationship and one a transactional one; the same holds for the two positive cases (Plastics-SPL, Semicon-SPL). Similarly, the two AutoseatsCo cases (Fasteners-SPL, Stampings-SPL) both involve transactional relationships but are associated with negative and positive technology adoption. One explanation as to why the relationship type did not seem to moderate the implementation process more strongly could be that the formal relationship type, transactional vs. collaborative, is overshadowed by the specific role of trust in the relationship. In the Fasteners-SPL case, the lack of trust noticeably impeded the adoption of the advanced digital should-cost tool, suggesting a negative moderating effect of relationship type on the readiness–practice link. Similarly, in the Semicon-SPL case, mutual trust enabled the EDI implementation, suggesting a positive moderating effect of relationship trust on the readiness–practice link. Therefore, we propose that trust exerts a moderating effect on the adoption of digital procurement practices, particularly when a deeper level of digital integration is targeted.

The results of the within-case analysis also point to the importance of both organizational readiness *and* technological readiness *in combination*. Technological readiness inhibited the adoption of digital technologies, despite sufficient organizational readiness, in the case of Electronics-SPL; meanwhile, low organizational readiness appeared to be the constraining factor in the case of Fasteners-SPL. This finding implies that companies need to have a certain level of both organizational readiness and technological readiness to successfully implement digital technologies.

Our empirical findings further suggest that the required level of the supplier's digital readiness depends on the *technological sophistication* that a digital procurement practice requires from the buyer and/or the supplier. Although the examined cases involve basic digital technologies that require relatively low levels of technological sophistication, the three negative cases demonstrate that a certain level of digital readiness nevertheless is needed for successful technology adoption. Analyzing the adoption patterns of digital technologies through the SCPV, we can see that the digital procurement practice of EDI, described in the IndustryCo cases, requires a higher level of digital readiness from the supplier side; meanwhile, digital readiness needs are lower for suppliers in the case of the advanced digital should-cost tool, analyzed in the AutoseatsCo cases. This finding implies that researchers should assess the degree of technological readiness in relation to the *technological sophistication* that a digital procurement practice imposes on or requires from the buyer and the supplier. We suggest that a digital procurement practice with a higher degree of technological sophistication requires a higher level of technological readiness.

Importantly, the findings from the case studies also reveal that the digital transformation of procurement at both IndustryCo and AutoseatsCo was at least partly impeded by the digital readiness level of their suppliers. IndustryCo's Head of Strategic Procurement explained that the heterogeneity of the supply base represented a challenge for digitalization:

> *Our supply base is quite varied; our suppliers are not all on the same level. We have world-class suppliers like Semicon-SPL. We do not need to teach these companies about digitalization. All you need to do with these world-class suppliers is to coordinate, discuss, find a win–win situation, and align which tools to implement and what kind of information to share. For the middle-sized and the low-end suppliers, we also need to promote digitalization, to educate them on its benefits for them.* (Head of Strategic Procurement, IndustryCo).

Interestingly, the variation across our nested case studies can best be explained by looking at both the buyer side and the supplier side. When digital procurement readiness is held constant for each buying firm, the differences between successful and unsuccessful implementation seem rooted in varying levels of digital readiness on the supplier side. In the nested cases of IndustryCo, successful implementation is associated with medium (Plastics-SPL) and high (Semicon-SPL) levels of digital readiness on the supplier side. In turn, unsuccessful implementation is associated with low (Packaging-SPL) and low-medium (Electronics-SPL) levels of digital readiness on the supplier side. In the nested cases of AutoseatsCo, successful implementation is associated with low-medium (Stampings-SPL) digital readiness on the supplier side, whereas unsuccessful implementation is associated with low (Fasteners-SPL) digital readiness on the supplier side. This clear pattern proposes that digital readiness on the supplier side is a key explanatory variable for the adoption of digital procurement practices.

The digital readiness matrix shown in Fig. 2 illustrates how combining the buyer-side and supplier-side perspectives results in a clearer picture of the alignments and misalignments for each dyad.

Fig. 2 shows the buyer's digital procurement readiness on the X-axis and the supplier's digital readiness on the Y-axis. The digital readiness matrix proposes that digital procurement practices can only be successfully implemented if *both* buyer and supplier show a certain level of digital readiness. Although a relatively higher level of digital readiness in a supply chain partner is not disadvantageous, our cases point to the likelihood that when a supply chain partner has a lower level of digital

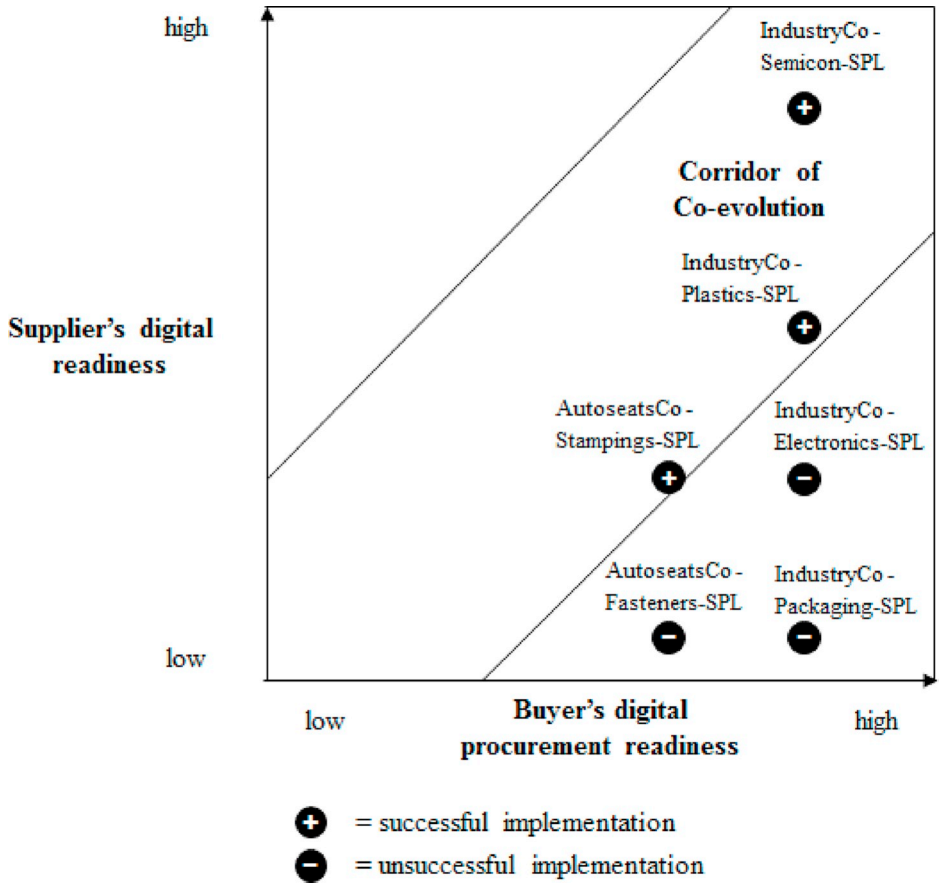

Fig. 2. Dyadic view on digital readiness.

readiness, it typically creates a bottleneck for the implementation of digital procurement practices. Attempts by buying firms to implement inter-organizational digital procurement practices therefore are more likely to fail if suppliers are not ready to follow on the digital transformation journey. Leading suppliers trying to implement advanced technologies with laggard buying firms are also likely to face the same challenge.

For example, IndustryCo's management recognized that digitalization could not stop at the factory walls; the firm needed to synchronize with its suppliers to deliver digitalization's full benefits. The Factory Manager explained:

> *If you really want to digitalize, clearly also the entire supply chain has to follow the same way. It is not working if only we are digitalized but then there is a break with our suppliers. From my point of view, the supply base also has to upgrade to the same level.… Clearly, procurement is playing one of the important roles in … really bringing digitalization to the suppliers in the next years.* (Factory Manager, IndustryCo).

6. Practice–performance link

Our empirical cases focused on the readiness–practice link, and the intermediate outcome we examined was whether the practice had been *adopted* or not. This study thus measured adoption in a binary way; however, we can also conceive of future studies that take more gradual measures of practice use, such as the adoption rate across a supplier portfolio or use as a percentage of transactions. Although the practice–performance link was not the focus of the present study, we now briefly discuss the observed performance outcomes.

The first tentative finding pertains to the absence of *systematic and specific performance measurements* for the effects of digital procurement practices at our case companies. None of the interviewees reported that their company tracked any performance indicators to specifically evaluate the effects of digital procurement practices. This finding apparently reflects a wider phenomenon in industry. A recent conference paper on digital procurement also finds that "neither literature, nor the company considered offer any performance indicators for measuring digital initiatives" (Elsaesser et al., 2019, p. 15). To provide managers with a more solid empirical basis for decisions on the adoption of advanced digital procurement practices, we therefore call for both researchers and practitioners who have already implemented pilot initiatives to measure more systematically the performance outcomes of digital procurement practices.

The digital procurement practices examined here (i.e., EDI, advanced digital should-costing tool) mainly targeted the efficiency dimension of performance (Cheung et al., 2011). For IndustryCo, the main goal of implementing EDI was to reduce lead times through efficient information exchange with suppliers. In the cases where EDI was successfully implemented (Plastics-SPL and Semicon-SPL), the interviewees on both sides of the dyad reported reduced operational workload, higher information accuracy, and faster information transfer. This observation is in line with extant literature, which finds that supply chain technology use is positively associated with a firm's delivery performance (Liu et al., 2016). For AutoseatsCo, the main goal of implementing the advanced digital should-costing tool was to increase the transparency of its suppliers' cost structure and to reduce purchase prices. In the case where the tool was successfully implemented (Stampings-SPL), the supplier confirmed that the tool had resulted in greater transparency and reduced purchase prices.

By increasing overall efficiency, inter-organizational digital procurement practices lead to *relational performance* – that is, to performance benefits mutually generated by two organizations that cannot be

generated by one of those organizations alone (Carter et al., 2017b). However, the cases seem to suggest that the share of relational performance appropriated by each supply chain member varies. Whereas IndustryCo's suppliers can probably appropriate at least some share of the relational performance for themselves through improved process efficiency, AutoseatsCo likely appropriates the largest share of the relational performance for itself in capturing reduced purchase prices. Determining the share of relational performance appropriated by buyer and supplier in a qualitative case study is difficult, but methodological approaches do exist to empirically assess the distribution of relational performance using dyadic quantitative data. For example, Cheung et al. (2011) conducted a multivariate analysis of variance (MANOVA) of a full set of dyadic relationships to test their hypothesis on the distribution of relational performance in buyer–supplier dyads.

7. Discussion and conclusion

To summarize our findings and transform them towards a forward-looking research agenda, in the following we delineate implications from our study for an SCPV on digital procurement and consider dynamic aspects of digital procurement readiness.

7.1. Toward a supply chain practice view on digital procurement

Our empirical observations demonstrate the value of the SCPV as a useful theoretical lens for research on digital procurement; it offers both theoretical grounding and strong managerial utility (Corley and Gioia, 2011; Spina et al., 2016). The SCPV provides a *holistic* framework that draws attention to three elements: 1) the antecedents that help explain *why* firms adopt digital procurement practices; 2) *how* the use of digital procurement practices unfolds; and 3) *what* performance outcomes can be derived from their use. In addition, the SCPV provides a *supply chain-specific* perspective that explicitly considers the interplay of supply chain partners at the dyad or network level of analysis for each of these three elements. In digital procurement, we see an area and a range of practices for which the theoretical potential of the SCPV can be fully realized.

An underlying assumption of the SCPV is that many of the digital procurement practices are imitable, and they are neither too surprising nor too technically complex for many firms to use (Bromiley and Rau, 2016). The digital procurement practices examined in the present study (EDI, advanced digital should-costing tool) meet the imitability criterion: The advanced digital should-costing tool that AutoseatsCo uses had been disseminated through a management consultancy, and EDI has found widespread adoption across industries. Even more advanced digital procurement practices, such as big data analytics, are often based on (customizable) software solutions that can usually be bought on the market.

Considering the notion that many digital procurement practices are transferable in principle, the question remains as to why certain firms adopt digital procurement practices while others refrain from doing so. Our empirical cases identified digital readiness as a key explanatory factor for the adoption of digital procurement practices in our empirical setting, incorporating factors such as top management support and IT infrastructure, which are neither rare nor inimitable. Yet, as suggested by a neo-configurational perspective (Kosmol et al., 2018; Misangyi et al., 2017), digital readiness is rarely the only factor influencing the adoption of digital procurement practices, and causation is often more complex. Our analysis identified environmental factors and relationship type as key moderators, while the concept of technological sophistication illuminated a key attribute of the digital procurement practice itself. Furthermore, we acknowledge that both structural states (e.g., digital readiness) and events (e.g., a failed EDI implementation attempt) can have an important effect on adoption (e.g., EDI adoption rate), as suggested by event system theory (Morgeson et al., 2015; Reimann et al., 2017).

Our findings further illustrate that a certain level of digital readiness on both sides of the buyer–supplier dyad is a critical antecedent to the adoption of digital procurement practices. This corroborates the original notion of the SCPV in which the authors called for researchers to investigate the conditions under which "organizations, dyads, or broader inter-organizational networks adopt certain practices or refrain from doing so" (Carter et al., 2017b, p. 119). When studying explanatory variables for digital procurement, research and practice should therefore consider not only the focal firm but also the dyad and the broader inter-organizational network.

7.2. Co-evolutionary perspective on digital readiness

The dyadic perspective of the SCPV on digital procurement, as discussed above, can be further extended by incorporating a dynamic view on change processes (Andreasen and Gammelgaard, 2018; Langley et al., 2013). As a variance-based theory, the SCPV thus far has been concerned primarily with knowing that SCM practice B is more effective than SCM practice A (Langley et al., 2013). However, Andreasen and Gammelgaard (2018) caution that "such accounts tend to ignore how to move from A to B … and thus ignore the actual change processes of PSM organizations" (Andreasen and Gammelgaard, 2018, p. 2). Therefore, complementing the inter-organizational perspective inherent in the SCPV with an angle for studying change processes can enrich the static picture on digital procurement with a dynamic view on the digital transformation journey. Given the rapid pace of digital transformation, incorporating this dynamism into the SCPV on digital procurement appears particularly relevant.

One possible avenue for moving in this direction would be to take a co-evolutionary perspective. Applied to the domain of digital procurement, the concept of co-evolution suggests that the buyer's and suppliers' digital readiness might each develop as distinct but mutually intertwined, co-evolutionary processes, where each party conditions the other's evolution (Kaufmann et al., 2016; Volberda and Lewin, 2003; Wilhelm and Sydow, 2018). This inherently dyadic concept implies that both the buyer and its suppliers should possess and develop certain degrees of digital readiness.

The digital readiness matrix, shown in Fig. 2, highlights the mutual dependency of the buyer's digital procurement readiness and the supplier's digital readiness, indicating a corridor of co-evolution. This *corridor of co-evolution* denotes rather synchronized development trajectories of digital readiness between the buyer and the supplier, and this synchronization is expected to facilitate the adoption of digital technologies over time. Low levels of digital readiness on both sides of the dyad might imply that supply chain partners can implement only basic digital technologies – but through the adoption process, they might mutually improve their digital readiness over time. High levels of digital readiness on both sides of the dyad might lead to higher aspirations by both parties and enable them to engage in more advanced digital procurement practices.

How the buyer's development pace relates to the pace of the supplier seems to play a critical role in the notion of co-evolution. Tentative support for this view is provided by IndustryCo's Head of Strategic Procurement, who suggested that buyers would need to adjust their digitalization pace to that of their supply base:

> *IndustryCo is not independent from its environment, from the city in which it is located, from China. You cannot be ten years ahead of others; then you could not integrate with suppliers. I think the best companies are three or five years ahead; then you can get the most advantages. But you cannot be successful if you are too quick.* (Head of Strategic Procurement, IndustryCo).

Thus, although the corridor of co-evolution suggests that *comparable/aligned* levels of digital readiness can facilitate the adoption of digital technologies over time, the concept also allows for *some* (temporary) differences between the digital readiness of the supply chain

partners. We can imagine the possibility of co-evolutionary mechanisms in supply chains, where the competitive dynamics play out in a way that buying firms exert influence on suppliers to adopt digital technologies, or that suppliers exert influence on buyers. For example, automotive manufacturers have successfully promoted the use of EDI technology in their supply chains through their buying power and the diffusion of industry standards (Agi et al., 2005; Huo et al., 2017).

Another possible avenue for moving in this direction would be to include *events* as explanatory variables in the SCPV. Events might include hiring a digital procurement officer or experiencing cyber-attacks in the supply chain; as such, they can trigger change processes and consequently can influence the trajectory of buyer–supplier relationships in critical ways (Morgeson et al., 2015; Reimann et al., 2017).

7.3. Managerial implications

Interest in the topic of digital procurement is growing quickly among practitioners, and many remain confused about which organizational prerequisites need to be in place to embark on the journey toward digital procurement. Our study aims to provide managers with *initial guidance* for analyzing their own and their supply base's readiness in terms of both organizational and technological factors. Importantly, managers should develop their digital procurement roadmaps with a close eye on the digital readiness of their supply base so that they co-evolve together with their supply network. Thinking of their suppliers' digital readiness as external to their own organization might intuitively seem true, but managers nevertheless should consider it to be a potential bottleneck on the road to digital procurement; avoiding the bottleneck requires proactive involvement by the buying firm. Buying firms can design certain incentive mechanisms (e.g., preferred supplier status and positive supplier evaluations) or invest resources (e.g., trainings or technical support) to help upgrade the digital readiness of certain key supply chain partners. Even when a buying firm has the necessary digital procurement readiness, a lack of readiness on the supplier side impedes the implementation of digital procurement technologies.

7.4. Limitations and future research directions

We acknowledge several limitations of this study that should be considered in the interpretation of its results. First, as with any qualitative research, despite a methodologically rigorous approach, the question of whether our insights can be generalized from our empirical setting to similar contexts is subject to future empirical research (Flyvbjerg, 2006).

Second, the present study considers only one specific explanatory variable at the (inter-)organizational level of analysis: digital readiness. We can conceive of further explanatory variables at various levels of analysis, such as individual-level characteristics, firm-level strategies, and country-level factors. In that vein, future research could adopt a neo-configurational perspective (Kosmol et al., 2018) and analyze which configurations of explanatory variables support the implementation of digital procurement practices.

Third, our study considered relational performance only at the dyadic level of a buyer–supplier relationship. However, relational performance also plays a role at the level of digital supply networks (Carter et al., 2017b). For example, the network performance of IBM's blockchain solution, which might increase visibility and efficiency in supply networks, could be measured as the aggregate performance of network participants (Forrester, 2018). Examining network performance further responds to a call from Srai and Lorentz (2019) to examine the implications of PSM digitalization beyond firm-level outcomes.

In addition, our study provides only an initial starting point for further research in this exciting area. Because of the nascent stage of the field and the pace of the ongoing development of digitalization, many unanswered questions remain.

APPENDIX

Appendix A. Literature Review Process

No.	Journal Name	Journal Area
1	Decision Sciences	Supply Chain Management
2	International Journal of Operations and Production Management	Supply Chain Management
3	International Journal of Physical Distribution and Logistics Management	Supply Chain Management
4	Journal of Business Logistics	Supply Chain Management
5	Journal of Operations Management	Supply Chain Management
6	Journal of Purchasing and Supply Management	Supply Chain Management
7	Journal of Supply Chain Management	Supply Chain Management
8	Supply Chain Management: An International Journal	Supply Chain Management
9	Information Systems Research	Information Systems Management
10	Journal of Management Information Systems	Information Systems Management
11	Journal of the Association of Information Systems	Information Systems Management
12	MIS Quarterly	Information Systems Management

Appendix B. Profiles of Interviewees

Interviewee	Firm[a]	Informant Job Title[b]	Years at Firm	Years in Current Position	Duration of Interview (in mins.)
X1	IndustryCo	Factory Manager	23	2	50
X2	IndustryCo	Head of Strategic Procurement	6	6	90
X3	IndustryCo	Head of Operational Purchasing	10	6	195
X4	IndustryCo	Purchasing Manager - Processes & Tools	5	1	80
X5	IndustryCo	Purchasing Manager - Processes & Tools*	12	7	80
X6	IndustryCo	Operational Purchaser	3	3	75
X7	IndustryCo	Operational Purchaser	10	1	55
X8	IndustryCo	Operational Purchaser	6	3	60
X9	IndustryCo	Operational Purchaser	4	4	55
X10	IndustryCo	IT Manager	1	1	50
X11	Electronics-SPL	Key Account Manager*	9	9	70
X12	Packaging-SPL	General Manager	10	10	90

X13	Plastics-SPL	Marketing Director	6	6	55
X14	Semicon-SPL	Key Account Manager	9	5	60
X15	AutoseatsCo	Manager Purchasing Process	5	3	55
X16	AutoseatsCo	Director Supplier Risk Management	9	2	25
X17	Fasteners-SPL	Commercial Manager*	2	2	20
X18	Stampings-SPL	Senior Commercial Manager	4	4	65

[a] Real names are concealed for confidentiality.
[b] Interviews were conducted face-to-face, except for the three interviews marked with an asterisk (*), which were conducted via telephone.

Appendix C. Semi-Structured Interview Guideline

Categories	No.	Questions for buying firms (suppliers)
General overview	1.1	What is your **role** in the organization and what **responsibilities** does it include?
	1.2	Can you please give me a **brief overview** of your **organization**?
Digitalization	2.1	How will **digitalization** affect the **procurement function** at your company (**your company**)? Please be specific and provide examples/anecdotes!
	2.2	How is digitalization incorporated into your **purchasing strategy (company's strategy)**?
Implementation roadmap	3.1	How would you describe your company's **current level of maturity** in terms of digital procurement **(digitalization maturity)**?
	3.2	Can you name some **examples of measures** contributing to the implementation of digital procurement (digitalization) at your company that have been completed/are planned?
	3.3	What has been the **path of implementation** of digital procurement measures (digitalization measures) so far?
	3.4	What is the future **roadmap for the implementation** of digital procurement (digitalization) at your company?
	3.5	How do you **measure the success** of digital procurement (digitalization) at your company?
Digitalization project	4.	Please recall a particular **key supplier** with whom your company has **successfully** implemented [met **challenges or difficulties** in implementing] a digitalization project during the **past 12 months (**Please recall the recent digitalization project [name/details to be added based on buying firm interview] in your relationship with **customer XYZ.)**
	4.1	Could you please give me an overview of this **supplier relationship (**your relationship with **Company XYZ)**?
	4.2	Can you please give me a brief **overview** of this **digitalization project**?
	4.3	Can you please give me a detailed account of **how you implemented** this digitalization project with the supplier (company XYZ)?
	4.4	What were the **largest hurdles** standing in the way of implementing this digitalization project with this supplier (company XYZ)?
	4.5	In your opinion, what were the important **enablers** for the successful implementation of the digitalization project with this supplier (company XYZ)?
	4.6	What were the **effects** of implementing this digitalization project with this supplier (company XYZ)?
Closing questions	5.1	Based on your experience, what other **important (but largely overlooked)** areas of digital procurement should we look at? Why? (Regarding the implementation of digitalization projects with company XYZ, did we **forget anything** that should be mentioned?)
	5.2	Are there **other people** at your company who you think we should talk with regarding digital procurement (the implementation of this digitalization project)?

[a] Certain aspects of the instrument were given more or less emphasis, depending on the position and knowledge of the interview partner.

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