2019

Data and Predictive Analytics Use for Logistics and Supply Chain Management

Anníbal C. Sodero
The Ohio State University

Yao Henry Jin
Miami University - Oxford

Mark A. Barratt
Marquette University, mark.barratt@marquette.edu

Data and Predictive Analytics Use for Logistics and Supply Chain Management

Annibal Sodero
Department of Marketing and Logistics, The Ohio State University, Columbus, Ohio
Yao Henry Jin
Department of Management, Miami University, Oxford, Ohio
Mark Barratt
Department of Management, Marquette University, Milwaukee, Wisconsin

Abstract

Purpose
The purpose of this paper is to explore the social process of Big Data and predictive analytics (BDPA) use for logistics and supply chain management (LSCM), focusing on interactions among technology, human behavior and organizational context that occur at the technology's post-adoption phases in retail supply chain (RSC) organizations.

Design/methodology/approach

The authors follow a grounded theory approach for theory building based on interviews with senior managers of 15 organizations positioned across multiple echelons in the RSC.

Findings

Findings reveal how user involvement shapes BDPA to fit organizational structures and how changes made to the technology retroactively affect its design and institutional properties. Findings also reveal previously unreported aspects of BDPA use for LSCM. These include the presence of temporal and spatial discontinuities in the technology use across RSC organizations.

Practical implications

This study unveils that it is impossible to design a BDPA technology ready for immediate use. The emergent process framework shows that institutional and social factors require BDPA use specific to the organization, as the technology comes to reflect the properties of the organization and the wider social environment for which its designers originally intended. BDPA is, thus, not easily transferrable among collaborating RSC organizations and requires managerial attention to the institutional context within which its usage takes place.

Originality/value

The literature describes why organizations will use BDPA but fails to provide adequate insight into how BDPA use occurs. The authors address the "how" and bring a social perspective into a technology-centric area.

Keywords

Big Data, Supply chain management, Grounded theory, Predictive analytics, Retail supply chain

Introduction

Technology use is of considerable interest in the logistics and supply chain management (LSCM) discipline (Daugherty, 2011). LSCM studies identify technology use as a social process involving significant learning, through which both technology and organization adapt to each other (Swanson et al., 2017). Operational excellence only ensues when users achieve a workable degree of compatibility between technology and organization (Premkumar et al., 2005). However, it may be challenging to achieve such compatibility. Successful technology use hinges on the critical role of people and organizational structures within and through which they operate (Williams and Edge, 1996). Without this relationship among technology, people and organization, the technology's potential will be underused or adoption may not even lead to its use (Orlikowski, 1992).

We aim to address this shortcoming in the literature by investigating the social process of technology use for LSCM. We focus on a specific technology – Big Data and predictive analytics (BDPA). BDPA use concerns voluminous and numerous flows of data capture, storage, aggregation, analysis and visualization, and the application of techniques to gain insight from them with timeliness and trustworthiness (LaValle et al., 2011). BDPA use can fundamentally transform supply chain and logistics functions and lead to value creation (Gunasekaran et al., 2017). Organizations, however, will need to overcome organizational, human and technical challenges for its effective use (Arunachalam et al., 2017).

Studies on BDPA-related initiatives for LSCM predominantly resort to the diffusion of innovations literature to describe organizational evolution through discrete stages of BDPA adoption toward use and to predict its outcomes (Gunasekaran et al., 2017). They describe why organizations strive to adopt and implement BDPA but provide limited insight into how organizations use the technology. In particular, they do not incorporate salient

social issues that occur post-adoption, when the technology diffuses across and becomes routinized in organizational projects and processes.

We address the following research question:

RQ1. How do organizations use BDPA for LSCM?

We focus on the social process through which technology, people and organizational context interact as their organization uses BDPA. Focusing on the social process of post-adoption technology use is important for two reasons. First, the technology may embed different organizational practices and become incompatible with the organizational context. Thus, organizations need to understand the nature of forces and actors involved in the social process that shapes BDPA. Second, technologies possess malleable components. Our focus offers an opportunity for a human-centered investigation of skills required to learn, adjust and adapt BDPA to achieve a desired level of compatibility with an LSCM context.

We use an inductive, interpretive and qualitative approach to theory building. We focus on retail supply chain (RSC) organizations, thereby adopting a network perspective, which provides nuanced insight into our phenomenon of interest. We chose this focus because of numerous specialized media announcements about BDPA-related initiatives for LSCM in this setting.

Our findings reveal the social process through which user involvement shapes BDPA to become compatible with organizational structures and how modifications to the technology retroactively affect its design and institutional properties. They also reveal the presence of temporal and spatial discontinuities in BDPA use across organizations. Our study contributes to the emerging stream of research on BDPA use for LSCM and answers calls for more investigation of BDPA-related phenomena in the discipline (e.g. Hazen *et al.*, 2014; Richey *et al.*, 2016; Waller and Fawcett, 2013; Arunachalam *et al.*, 2017; Papadopoulos *et al.*, 2017).

A priori sensitizing literature

Technology use

Technology use studies have developed along two perspectives: the decision-making and the institutional (DeSanctis and Poole, 1994). The decision-making perspective adopts a positivist approach aiming to measure effects of technology use on organizational outcomes. It conceives technology as structures (i.e. data and decision models) designed to overcome managerial bounded rationality. Thus, it assumes that technology can shape human cognition and behavior. Within this perspective, the task-technology fit model (Jarvenpaa and Ives, 1993) posits that successful implementation of new technology depends on how well a technology's characteristics are compatible with both task-specific requirements and users' individual abilities (Drazin and Van de Ven, 1985).

In contrast, the institutional perspective focuses more on the evolution of socio-technical systems than on effects of technology use (Markus and Robey, 1988) and characterizes technology as "interpretively flexible." The interpretive analysis becomes "the process of looking beneath the obvious surface of technology's role in organizational change to uncover the layers of meaning brought to technology by social systems" (DeSanctis and Poole, 1994). That is, the institutional perspective posits that a combination of user influence, decision makers and context shapes technology into a final product of human action, design and appropriation (Orlikowski, 1992). Under this perspective, an organization's socio-technical systems determine technology compatibility (Bostrom and Heinen, 1977). Successfully aligning an organization's social (e.g. employees and values), technical (e.g. devices and tools) and environmental (e.g. customers, rules and regulations) systems is essential for optimal organizational performance (Trist, 1981).

The concept of BDPA use and its applicability in the RSC

BDPA use comprises two dimensions: "Big Data" and "predictive analytics" (Wamba *et al.*, 2017; Gunasekaran *et al.*, 2017). "Big Data" involves the ability to capture, store, aggregate and analyze high-volume, high-variety and high-velocity information assets with high veracity. In turn, "predictive analytics" involves the ability to gain insight from Big Data (Chen *et al.*, 2012; LaValle *et al.*, 2011). BDPA use refers to an organization's ability to integrate, build and reconfigure internal and external competencies to address rapidly changing environments; thus, it is a dynamic capability (Wamba *et al.*, 2017; Richey *et al.*, 2016). Creating and sustaining dynamic capabilities require costly investments and can lead to superior performance (Eisenhardt and Martin, 2000).

BDPA use is pivotal in retailing. For example, Walmart collects every hour, from customer transactions, a volume of data exceeding 2.5 petabytes (Marr, 2017). Moreover, RSC organizations have increased the variety of data they use in unstructured, non-tabular format. Furthermore, the rapid velocity of BDPA use can provide agility and responsiveness (LaValle *et al.*, 2011) for RSC organizations to gain significant competitive advantage (Pagell and Krause, 2004). Rapid insights become possible as RSC organizations use continuous flows of data (Davenport *et al.*, 2012), such as those on changes in consumer sentiments, to treat the market as a "conversation" between their business and consumers, instead of traditional business-to-customer one-way interactions (Chen *et al.*, 2012).

The validity of such insights, however, hinges on veracity, or the spuriousness of data and results (McAfee *et al.*, 2012). BDPA use leverages an overwhelming level of statistical power to overcome potential measurement inconsistencies in the voluminous data quickly accumulating in real-time from many sources (Davenport *et al.*, 2012) and supplements intuition-based decision making with a data-driven approach (McAfee *et al.*, 2012). This approach may help to overcome managerial bounded rationality and pre-conceived perceptions and judgments that lead to sub-optimal decisions. Ultimately, BDPA use allows RSC organizations to explore new opportunities and innovations, execute their current business models and decommission parts of their business that are not working (Fisher and Raman, 2018).

BDPA use for LSCM

The extant literature on BDPA adoption and implementation has focused more on pre-adoption intentions than on post-adoption behavior and has produced insights mostly at the individual level (e.g. Hazen *et al.*, 2014). There is a scant research on actual post-adoption BDPA use – i.e., the extent to which the technology "diffuses across the organizational projects or work processes and becomes routinized in the activities of those projects and processes" (Purvis *et al.*, 2001, p. 121).

Existing LSCM studies (summarized in Table I) identify key drivers of BDPA use, such as managerial commitment, organizational readiness, resource dedication, technological capability and talent availability. Ultimately, BDPA use enables organizations to reap potential benefits associated with value creation and competitive advantage (Schoenherr and Speier-Pero, 2015; Sanders, 2016; Gunasekaran *et al.*, 2017; Chen *et al.*, 2015; Richey *et al.*, 2016; Arunachalam *et al.*, 2017). Research in the LSCM domain uses a variety of methodologies (e.g. case studies and surveys) and theoretical perspectives (e.g. dynamic capabilities and contingency) to advance the literature. For instance, Schoenherr and Speier-Pero (2015) provide recommendations for training data scientists, Sanders (2016) develops a maturity model for BDPA implementation, and Richey *et al.* (2016) identify key strategic factors in an international setting.

The extant LSCM literature thus predominantly adopts either a deterministic view (i.e. adoption inevitably leads to certain outcomes) or a contingency view (i.e. situational factors interact with usage to cause outcomes) to predict outcomes for organizations at various stages of BDPA assimilation. It assumes that BDPA use becomes "stabilized" by focusing mainly on short periods immediately following adoption. Such an assumption fails to

acknowledge that technology users tend to redefine and modify BDPA's properties and purpose post-adoption, as they harness BDPA's high degree of configurability, programmability and interconnectedness within and across organizations in the supply chain. Gaining insight into the process by which BDPA use becomes institutionalized and the active role played by users on organizational and technological changes can provide a deeper theoretical understanding of how BDPA use and organizations co-evolve.

Methodology

We employed a grounded theory approach to theory building. This approach is appropriate because it enables deep and rich theoretical descriptions of the social nature of a phenomenon (Glaser and Strauss, 2017; Randall and Mello, 2012; Denk et al., 2012). Grounded theory's interpretive approach gives voice to interpretations of those who are living the experience (Walsham, 2006), which is particularly suited in novel empirical contexts (Mello and Flint, 2009). Emergent theory derived from grounded theory is descriptive, rather than functional or causal, and provides in-depth understanding of a phenomenon by emphasizing metaphors derived from the field and constructed by the researcher (Van Maanen, 1979).

We followed the Gioia method (Gioia et al., 2013) to implement grounded theory. In contrast to case study-based approaches to theory building, which embrace a prescriptive purpose and aim to derive propositions that link together constructs, the Gioia method focuses on "processes by which organizing and organization unfold" by capturing "experiences of knowledgeable agents to scientifically theorize the social construction underlying organizational processes" (Gehman et al., 2018, p. 286). This method's primary aim is descriptive in nature, as it seeks to systematically describe dynamic relationships through transitioning informant-centric terms to researcher-centric concepts among emerging constructs (Gioia et al., 2013; Langley and Abdallah, 2011).

This section first reports sampling and data collection. Then, it details data coding and starts the presentation of findings by describing emerging concepts. The next section continues the presentation of findings in the form of a grounded theoretical framework. The framework connects concepts to capture the meaning of the social process of BDPA use for LSCM. Table II presents a summary of validity and reliability establishment through recommended practices in qualitative exploratory research and grounded theory methodology (Mello and Flint, 2009; Gioia et al., 2013; Gammelgaard and Flint, 2012; Manuj and Pohlen, 2012).

Sampling

BDPA use for LSCM remained elusive (Papadopoulos et al., 2017). Thus, gaining insight into the social process underlying BDPA use in the RSC required recruiting organizations that had ongoing attempts at incorporating BDPA use and viewed it with heightened salience. We generated the potential pool of participants through "planned opportunism" (Pettigrew, 1990, p. 274). We recruited from member organizations in one of the largest LSCM academic research centers in the USA, with whom we had opportunities for informal interaction during long-standing relationships. In this way, we were familiar with the organizations and their contexts, which allowed us to interpret their organizational realities to capture and establish meaning.

We identified organizations where users both accepted BDPA and considered it technically feasible, and whose efforts at implementing BDPA had yielded obvious and meaningful changes to both the technology itself and organizational processes. Finally, we sought to capture spatial and temporal differences in the social process of BDPA use for LSCM by recruiting retailers, vendors and third-party logistics (3PL) providers.

We used purposeful sampling to determine which organizations to interview first. Purposeful sampling involves choosing informants having the best knowledge about the phenomenon in question (Lincoln and Guba, 1985). In addition, we used theoretical sampling. We pursued data relevant to the grounded theory emerging from the ongoing analysis. We constantly compared data across informants over time. As we oscillated between data

collection and data analysis, we kept adding interviews until we achieved theoretical saturation, when further data collection and analysis yielded no further explication of a given category or concept (Glaser and Strauss, 2017). In total, we conducted 15 interviews, a number consistent with extant interpretive research in LSCM and exceeding the minimum suggested by McCracken (1988) for exploratory qualitative research. Table III describes the selected organizations and their application of BDPA use[1].

Data collection

We conducted semi-structured interviews with senior managers, who are the most appropriate source of information for technology-related initiatives (Tallon *et al.*, 2000). We asked informants to speak as the representative voice of the collective (i.e. RSC). All interviews lasted between 1 and 2 h. We guided each informant beyond prompts for each question with follow-up questions to stimulate the conversation and derive additional insights (see "Initial Semi-Structured Interview Protocol"). Progressively, we restructured our interviews to reflect emergent concepts. We recorded and transcribed all interviews. To improve construct validity, informants reviewed transcripts.

Initial semi-structured interview protocol.
1. Big Data and predictive analytics (in general).
> Q1: What does BDPA mean to you? How would you define BDPA?
> Q2: What do you think that BDPA has to offer to your organization?
> Q3: Do you think that BDPA is the most important supply chain technology currently on the horizon?
Follow-up: why is that?
> Q4: Do you think Big Data will spur a broad range of industries to develop and shift toward innovative physical capabilities?
> Q5: Specifically, to what extent and how will "Big Data" impact your organization?
2. Assimilation of Big Data and predictive analytics.
> Q6: What is your organization's approach to BDPA (not assimilated; routinized; fully assimilated and using)?
Follow-up: why is that?
> Q7: What are you using BDPA for (marketing and sales; after-sales services; procurement; supply chain design; planning and coordination; human resources management; finances; security and fraud)?
Follow-up: how are you using it?
3. Information technology in the organization.
> Q8: To what extent does your organization use ERP, APO, EDI, TMS and WMS?
> Q9: Do you believe that your organization has enough people with extensive data analysis skills to fully utilize BDPA?
> Q10: Do you believe that your organization has enough storage capacity to effectively use/test BDPA?
> Q11: Do you believe that your organization effectively uses currently available data?
> Q12: To what extent does your organization work closely with IT service providers?
> Q13: What types of data (consumer; transactional; environmental) does your organization collect on a daily basis?
Follow-up: What are their sources?
Follow-up: What is the nature of these data (qualitative vs quantitative; structured vs unstructured)?
> Q14: To what extent does your organization have difficulty in collecting and analyzing large amounts of data?
Follow-up: why is that?
> Q15: How regularly does your organization have to expand storage capacity for data?
> Follow-up: is the frequency of this expansion increasing?
> Q16: How close to real-time does your organization make decisions based on the data you collect and analyze?
> Q17: To what extent is the data you collect trustworthy?

4. Operating environment and organizational design
　　　Q18: How predictable is the operating environment in which you trade?
　　　Q19: How would you describe your organization's operational processes in terms of complexity?
　　　Q20: To what extent does your organization use cross-functional teams?
　　　Q21: How much visibility do you have both internally and externally (both suppliers and customers)?
　　　Q22: How much collaboration have you pursued with customers and suppliers?

Data analysis

Following established guidelines (Glaser and Strauss, 2017; Suddaby, 2006; Gioia *et al.*, 2013), two researchers coded transcripts immediately after each interview and a third researcher reviewed coding. We reconciled notable differences through iterative discussions. We assembled all statements of interest into a database comprising sentences, which conveyed a coherent point about the social process of BDPA use in the RSC. We coded statements into categories and further lifted them to the conceptual level. Finally, we aggregated similar concepts into overarching dimensions. Such a recursive, process-oriented and non-linear analytical procedure continued until we had a clear grasp of underlying theoretical relationships, and additional interviews failed to reveal new data relationships to achieve theoretical saturation.

Figure 1 illustrates our final data structure and Table IV presents supporting data. Below, we present the three aggregate dimensions that emerged from our data analysis: organizational context, BDPA itself and human behavior.

Organizational context

Three institutional properties related to the organizational context: operational complexity, supply chain integration (SCI) and top management involvement.

Operational complexity

As retailing transitions to multichannel operations, operational complexity in the RSC becomes more prominent. Operational complexity in the RSC represents the uncertainty degree associated with managing dynamic variations, in time or quantity, across information and material flows (Flynn *et al.*, 2016). Proliferation in product lines and assortment generally increased demand unpredictability (Germain *et al.*, 2008). That, in turn, exacerbated forecasting difficulties, even when the organization was customer-centric and had a clear market orientation to generate, disseminate and respond to market intelligence (Fugate *et al.*, 2008). As the informant from VENCO#4 stated, "For the supply chain, there are lots of different nodes, so [BDPA] will be a huge enabler to all elements of the supply chain."

Supply chain integration

Echoing extant research (e.g. Richey *et al.*, 2016), informants expressed that BDPA-related initiatives and SCI were intertwined. SCI is complex and multifaceted both within and across organizational boundaries (Jin, Williams, Tokar and Waller, 2015; Jin, Williams, Waller and Hofer, 2015) and vulnerable to operational complexity (Flynn *et al.*, 2016). In particular, informants reported that engaging in BDPA-related initiatives depended on both inter-functional and interorganizational collaboration, for instance, to capture data and proactively respond to uncertainty. A comment from VENCO#6 about customer resistance to both technological and behavioral changes necessary to shift away from a "big batching environment," which carries the time delay that hinders the effectiveness of real-time analytics to improve speed of delivery, exemplifies such dynamic.

Top management involvement

Also consistent with extant research (Gunasekaran *et al.*, 2017), the analysis demonstrated that top management involvement establishes priorities and goals. Informants suggested that tangible BDPA-related

initiatives were at play only when top management provided explicit directives of engagement and allocated resources (e.g. for data collection, hiring, and systems update).

BDPA itself

We identified three concepts that offered insight into the technology itself: technological capabilities, data pools and validation tools.

Technological capabilities

Technological capabilities increasingly have become enablers of LSCM (Grover and Kohli, 2012). Technological capabilities enable RSC organizations to improve performance outcomes such as production efficiency (Devaraj *et al.*, 2007), targeted marketing promotions (Aloysius *et al.*, 2016) and reverse logistics (Daugherty *et al.*, 2005). More recent developments (e.g. radio-frequency identification) further help retailers to capture fine-grained data to improve inventory management outcomes such as on-shelf availability and inventory record inaccuracy (Hardgrave *et al.*, 2013).

Most importantly, technological capabilities may serve as indicators of an organization's readiness to effectively use emerging technologies (Kurnia *et al.*, 2015). This readiness hinges on the role of data scientists (Waller and Fawcett, 2013), who possess technical skills and business acumen to utilize the technology. Our informants indicated a shortage of such professionals in the RSC and the marketplace at large. They implied that this shortage is a major deterrent for them to leverage BDPA use's potential.

Data pools

Organizations have increasingly leveraged technologies to amass data to glean actionable business intelligence (Mukhopadhyay *et al.*, 1995). In the RSC, unstructured data increasingly joined data pools created through collection of conventional transaction data (LaValle *et al.*, 2011). In general, organizations knew the kind of data they were interested in collecting (Brown *et al.*, 2011). To make these data pools more manageable and suitable for manipulation and visualization on individual workstations, organizations tended to rely on various forms of data aggregation techniques (Jin, Williams, Tokar and Waller, 2015). According to the informant from 3PLCO#1: "[BDPA use comprises a] lot of variables from different sources and something you can't calculate easily historically."

Validation tools

The reliability of data and results of data analysis remained highly questionable and required validation (Jin, Williams, Waller and Hofer, 2015). Our informants frequently expressed concerns over trustworthiness. This was because information systems managers, who may lack understanding of the data's intended use, often designed and implemented validation tools (Wang and Strong, 1996). These validation tools will remain an important area of concern for BDPA use, as illustrated by the following quote: "So, there is still that question, there always seems to be a question around data, as to whether it is valid or not, and I think that is the biggest obstacle that we have to overcome" (VENCO#1).

Human behavior

We identified behaviors that contributed to the social process of BDPA use for LSCM: decision making for value creation, technology design and redesign, and inaction.

Decision making for value creation

Value creation is an expected outcome of technology use, generally (Purvis *et al.*, 2001), and of BDPA use for LSCM, specifically (Chen *et al.*, 2015). The literature highlights the impact of information technology use on customer experience (Bowersox and Daugherty, 1995) as a key tenet of the evolution of retail to multichannel operations (Waller and Fawcett, 2013). It also highlights how retailers sharing demand planning and inventory

management information with suppliers can create value (Jin, Williams, Tokar and Waller, 2015). Because organizations in our sample had been leveraging information technology for their LSCM decision making increasingly, our informants expected BDPA use to yield similarly positive results.

Technology design and redesign

Parameters for technology customization tend to be user driven (Eason, 2014). Moreover, technology use requires an iterative process, in which input from users is expected to drive additional changes by information system managers (Karahanna *et al.*, 1999). Informants indicated great dependence on third parties, both internally and externally to their organization, to make changes to existing technology. In some instances, they had to resort to using temporary patches while waiting for the implementation of changes.

Inaction

When facing financial constraints, managers often choose to act conservatively and make no capital investments perceived as risky (Hambrick and Schecter, 1983). Such managerial inaction, in turn, may be interpreted as indifference or indecisiveness (Garud and Van De Ven, 1992). Specific to information technology use, managerial inaction is not isolated to pre-adoption. During post-adoption, perceived socioeconomic and political threats from a newly adopted technology may yield user resistance acts ranging from neutrality to aggressive resistance (Swanson *et al.*, 2017). Our informants described inaction regarding BDPA use resulting from managerial attention shifting to other organizational priorities or to daily routines. There was also a general sense of confusion regarding what it took to make effective use of technology, as the following quote from VENCO#3 illustrates: "And there is a consistent message that it was great for that initial flood of what is [BDPA], but I found very little on what do you do with it!"

The social process of BDPA use for LSCM

Our grounded theoretical framework (Figure 2) describes dynamic relationships among organizational context, human behavior and BDPA itself. Table V provides evidence of relationships.

Organizational context of BDPA use

The organizational context shapes BDPA use. People draw on existing resources, knowledge, norms and rules to perform their work (Williams and Edge, 1996). By invoking these structures that convey meaning, legitimacy and power (Zucker, 1987), actors were able to justify behavior concerning BDPA use.

Although most informants expressed awareness of BDPA-related initiatives taking place within their organizations, their actual attention to them and their organizations' effort levels toward effective use differed, depending on top management's endorsement of BDPA use as a priority. We detected inaction when there was a lack of top management involvement; managers' attention was dispersed, diffused or even elsewhere. We found that managers did commit to BDPA use when it was a priority or at least an important initiative, particularly for the formation of data pools.

Without the support from top management, decision making for value creation continued reflecting existing, pre-established goals. Designers and programmers performed limited technological modifications aimed toward the improvement of performance metrics. This finding shows how actors' perceptions about top management's expectations constrained and encapsulated BDPA use's transformative power.

SCI was paramount in determining behavior. SCI stipulated the scope, level and degree to which people within the RSC engaged in BDPA use. Most informants reported dependence and reliance on their partners to be able to take action. Interestingly, confusion ensued among many informants, as increasing amounts of data flowing upstream in the RSC overwhelmed them. "It's not that we can't store it but that we don't know what to do with it," argued the informant from 3PLCO#2, while others claimed they could only use data that had already passed

a "cleaning process." Moreover, the lack of knowledge of what happened beyond the supply chain function, particularly in marketing (in most cases considered responsible for dealing with social media data), was also a factor that influenced actors' approaches to BDPA use. In general, informants were unable to use unstructured data. In addition, they were incapable to direct developers to modify the systems to make effective use of them.

Confusion and lack of awareness were not the only drivers of inaction, though. For those informants whose perceived levels of SCI were high, BDPA use was less pressing. The sense of achieving pre-stipulated performance levels through SCI precluded managers from engaging in new activities. That included requesting technological changes, which might affect the status quo.

Finally, informants also underscored that operational complexity was driving inaction because of their inability to deal with the highly uncertain and movable operational landscape. At the same time, managers were pushing for technological modifications to cope with operational complexity, including the need for decision-making tools in the new scenario.

BDPA as an outcome

When architects and developers view technology merely as a tool (i.e. hardware and software), they design technology that reflects their biases, assumptions and beliefs. Further, users – like system engineers and software developers – will continuously modify and reshape a technology based on their preferences. The eventual value created by both technology and subsequent modifications is largely dependent on users completing their tasks (DeSanctis and Poole, 1994). That is, people design and build a technology, which also co-evolves with its users and their purpose.

Influenced by the institutional properties of RSC organizations, developers constructed and modeled BDPA to meet managerial goals. Thus, BDPA became inherently limited. Informants reported that efforts to increase BDPA use had centered on building data pools, validating such data through triangulation and cleaning, and relying on data analysts to glean useful insights from such efforts. To retrieve these data for analytical use, managers tended to rely on technicians to extract desired information. The outcome of this process depended on managers' understanding of business questions and ability to communicate them to technicians clearly. It also depended on technicians' interpretations of managers' requests, their ability to manipulate data pools, and the subsequent transmission back to the managers.

Because of human inaction, BDPA itself was clearly not changing and, although not claimed by any informant explicitly, was becoming outdated and possibly obsolete quickly. Conversely, for those taking action, BDPA was in a constant state of flux. Decision makers transformed BDPA as they generated organizational knowledge using multiple tools.

BDPA as a conduit

Although the emerging literature on BDPA use for LSCM seeks to identify whether a technology has an effect on various performance measures, results from our study highlighted that BDPA itself is a tool and not a process or strategy that can influence firm outcomes directly. That is, simply investing in BDPA use will not determine performance *per se*. In general, respondents indicated that BDPA use both empowers and hinders an organization's ability to accomplish its goals based on how it deploys and uses the technology.

BDPA use had multiple purposes (e.g. forecasting, optimization, planning and control), ultimately leading to performance improvements. BDPA use allowed managers to focus on customer needs more effectively. Customer insights gleaned from BDPA use allowed managers to direct their attention to improving customer experience, particularly by stocking products according to customers' needs. As the informant from VENCO#2 said: "[Demand is] certain when [consumers] buy a product, and that's the piece that we have never properly

translated." The value of BDPA use is particularly evident when environmental uncertainty due to intense market competition requires organizations to be strategically nimble (Jin *et al.*, 2017).

Moreover, upstream informants pointed to EDI as the dominant form of information gathering from outside the organization. BDPA offered ancillary streams of information that required no customer collaboration to gain insight into end users' attitudes and behaviors. The informant from VENCO#3 reflected this sentiment: "We use [EDI data] a lot as an organization in the marketing sense […] it helps us to [manage] supply chain differently as a manufacturer." Most suppliers believed that customer collaboration via information sharing remained the most important resource for effective planning. However, their expectation was that BDPA use might further assist in improving on-shelf availability and new product development.

BDPA use was hindered when actors were unable to uncover how to deploy the technology upon implementation and scrambled to maximize its use. As the informant from VENCO#5 stated: "I have to deliver cases to the business and I have not figured out yet how to apply [BDPA], how to leverage [BDPA]!" Furthermore, BDPA's role as a conduit for achieving organizational goals may not be effective without cross-functional and top management buy-in. Finally, users must be willing to understand BDPA's differences from conventional systems (e.g. business intelligence) to take advantage of its use.

BDPA as a catalyst

When actors interact with a technology, they typically reinforce institutional properties or, to a lesser extent, transform them, even though they may be unaware of their role in doing so. Actors who conform to embedded norms, rules and procedures in a technology contribute to maintaining the status quo. In turn, actors who do not use the technology as intended may undermine or even transform the norms, rules and procedures that form the institutional context in which the technology was developed. In this way, BDPA may transform organizational processes or strengthen their inertia.

BDPA use fundamentally transformed the way RSC organizations approached issues, ranging from operational considerations to strategic goals. At the micro-foundation level, RSC organizations that sought to expand BDPA use changed the way their managers approached decision making. In this transformation, data-driven insights supplemented or even supplanted, with statistical support, intuition-driven decisions within the confines of existing processes. This transformation was particularly impactful, as organizations that had long relied upon intuitive decision making also viewed traditional data-driven insights with skepticism. For instance, the informant from VENCO#6 argued: "[BDPA use helped to lessen] generalization and intuition and it is more about being specific and listening to what the data says."

Improvements that resulted in process effectiveness also led to reassessment and reevaluation of organizational goals and strategies. As organizations initiate BDPA use, incremental improvements through initial pilot projects often become the basis for expanded deployment in other aspects of their processes to allow managers to reimagine their potential capabilities. Along with this change in vision, new products, services and even business models encourage organizations and their RSC partners to reconsider their overall competitive position relative to peers. As described by the informant from 3PLCO#4, BDPA use was instrumental in their ability to communicate necessary changes to a major manufacturer that contracted them for direct-to-consumer deliveries. Since the manufacturer focused on building better products, 3PLCO#4 needed to convince the manufacturer to invest more in delivery and installation. BDPA use was pivotal in 3PLCO#4's ability to answer: "How can we work with our customers to create a more positive customer experience for our customer's customer?"

Within each RSC organization, BDPA use favored structural changes. This was because BDPA use altered institutional roles, as insights gleaned from it trumped the value of institutional and process knowledge.

Paradoxically, the transformational power of BDPA use served as a catalyst for social processes that both preserved and reinforced existing institutional properties. To successfully access the technology, users were subject to existing power structures within their firms. However, these determined investments toward BDPA use. To further deploy the technology and gain access to the insights it offered, users depended on those with technical expertise in BDPA use, including how to modify the technology. The following quotation from VENCO#2 illustrates this: "Well, [we need] just to have the people with the technical expertise to be able to manipulate the data and understand it, format it, publish it, and tell people what it means."

Discussion and conclusion

As RSC organizations face the challenge of operating multiple channels, BDPA use provides an opportunity for them to gain deeper market insight and improve performance. Given the exploratory nature of our research, the findings provide a springboard for more investigation into phenomena in the realm of BDPA use, not only in the RSC context, but also in the LSCM discipline, more generally. We uncovered previously overlooked relationships among BDPA, human behavior and the organizational context in which BDPA use occurs. Thus, we provide a more nuanced approach to the phenomenon under inquiry.

Academic contribution

The interplay between BDPA and the social structures where it operates, by which each shape the other, form the crux of the social process of BDPA use for LSCM. That helps explain why it is so difficult to predict the outcome of engagement in BDPA adoption. BDPA use is full of dualities. First, BDPA use requires vast amounts of resources, which require top management involvement. Top management, however, may neither understand the technology nor anticipate payoffs of its adoption. Second, BDPA use motivates organizations to engage in customer micro-segmentation, which has the potential to increase operational complexity, thereby posing a barrier to BDPA use. Third, BDPA use both requires and demotivates collaboration, in that effective use requires cross-functional teams. A paradigmatic shift from institutional knowledge-driven decisions to data-driven decisions may create rifts among functions, which also hinder BDPA use.

Moreover, an important aspect of this study is its network perspective – i.e., the RSC, not the individual organization. This approach permitted the observation of a critical element otherwise overlooked – that BDPA use is discontinuous in time and space. If the supply chain must act as a whole in the pursuit of a common goal, then the obvious mismatch across RSC organizations regarding BDPA use may become a recipe for disaster. Our analysis captured a clear dependence among supply chain partners for data integration and process alignment, even though each had a different goal in mind (e.g. better forecasting for suppliers, route optimization for 3PLs or on-shelf availability for retailers). Our framework suggests that differences in needs, goals and objectives, which are part of different organizational contexts and social structures, pose a challenge to BDPA use efficacy.

Managerial implications

Managerial implications are threefold. First, we unveil that it is impossible to design a BDPA technology ready for immediate use. The social process makes BDPA use specific to the using organization, as the technology comes to reflect organizational properties and the wider social environment. Therefore, RSC organizations must devote at least as much attention and resources to the post-adoption phase as they do to assess the potential of BDPA at pre-adoption.

Second, our framework allows managers to conceive and examine the interaction among technology, organization and human behavior at multiple levels of analysis. It suggests that organizations too focused on one aspect of BDPA use may be overlooking other aspects that can influence its success considerably. In particular, the institutional environment and its actors determine how an organization will use BDPA significantly.

Finally, by moving across levels of analysis and boundaries of time and space in the RSC, the framework affords an examination of BDPA transfer across organizations. It is not because BDPA use has succeeded or failed in one organization that it will achieve the same outcome at another organization in the same RSC. Managers must devote efforts to assisting partnering organizations to achieve same levels of success in BDPA use or to avoid causes of failure otherwise.

Future research directions

Interview-based research, particularly when using a grounded theory approach, often raises concerns about generalizability. Although the use of 15 organizations is consistent with extant inductively oriented research in the LSCM field, it is possible that we have missed additional insight by not including additional representative organizations. For instance, including those that generate content on the web (e.g. Ignite Social Media), analyze social media data (e.g. Inmar), research the market (e.g. Nielsen) and provide consulting services (e.g. Deloitte) might add to our inquiry. Nevertheless, there is nothing unusual in the RSC context. BDPA use for LSCM is increasingly common across other product-oriented industries. Such stakeholders left out by our inquiry are present there. This lends confidence that similar processes are likely in other settings.

Our methodological approach provides a basis for developing formal theory about BDPA use for LSCM. However, the focus on USA-based organizations may have left out important factors that vary according to the institutional environment. For instance, organizational culture is one important property in the organizational context (Ghoshal and Bartlett, 1994). Future studies could focus on establishing whether concepts and relationships that constitute our conceptual framework remain consistent across contexts. For instance, studies could investigate BDPA use for LSCM in emerging economies, where cultural forces are likely to shape technology use differently (Saldanha *et al.*, 2015).

Moreover, data collection at functions beyond LSCM, both internal and external to RSC organizations, could determine potential differences in BDPA use patterns. This is because our conceptual framework relies on meanings of reality conveyed by the interviewees, whose responsibilities are confined to a limited set.

Furthermore, research could focus on outcomes of BDPA use. Specifically, a natural extension of this study might be an investigation into performance implications of BDPA use. Research should be careful, however, to address inherent endogeneity. Better-performing organizations are, in general, more capable to invest in BDPA use and to reap its benefits because of their resource endowments.

Finally, research could investigate BDPA use from different theoretical perspectives. In particular, the resource dependence theory (Pfeffer and Salancik, 1978) from organizational studies and the technology acceptance model (Venkatesh and Davis, 2000) from information systems are competing viewpoints. They could provide alternative explanations for our findings inasmuch as they focus on different levels of analysis.
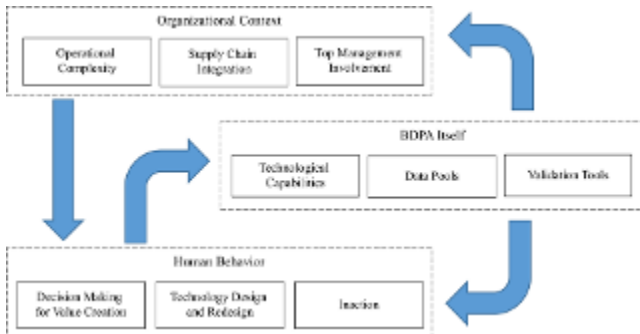
Figures

Figure 1 Data structure

Figure 2 The social process of BDPA use for LSCM

Table I Studies of BDPA use for LSCM

Study	Comments
Schoenherr and Speier-Pero (2015)	An assessment of the current state and potential of BDPA use for LSCM. The authors conducted a survey and interviews and used their own expertise in the field
Chen et al. (2015)	An empirical assessment of antecedents and outcomes of BDPA use for LSCM using survey data. The theory-based study relies on the technology-organization-environment framework
Sanders (2016)	Use of case studies and interviews to examine how leading organizations use BDPA for LSCM. The study offers a framework for implementation based on a maturity model
Richey et al. (2016)	A qualitative study using a native categories methodology based on interviews. The focus is on the key strategic determinants of BDPA use for LSCM
Wamba et al. (2017)	Use of survey data and structural equation modeling to test the resource-based view of the firm and propose a BDPA capability model
Arunachalam et al. (2017)	A systematic literature review to propose a BDPA capabilities maturity model
Gunasekaran et al. (2017)	Use of survey data and multiple regression analyses to test the resource-based view of the firm. The authors propose a model of the impact of BDPA assimilation on supply chain and organizational performance

Table II Assessment of the validity of the qualitative analysis

Validity criteria	Means to address criteria

Objectivity and confirmability: establish relative neutrality and reasonable freedom from unacknowledged researcher biases	Appropriate research design and detailed and explicit data collection approach
Reliability, dependability and auditability: establish whether the study's approach is consistent and reasonably stable over time and across researchers	Appropriate selection of informants according to the research question, crafting of instruments and protocols, transcription of all interviews, development of interviews' database, coding checks to ensure agreement among coders, and informants' reviews of transcripts and codes
Internal and construct validity: establish chain of evidence	Use of theoretical framework, use of multiple sources of evidence and context-rich data collection
External validity: establishes a domain in which the study's findings can be generalized	Clear description of the organizational context and the specific environmental and organizational considerations for the studied organizations
Utilization, application and action orientation: establish what the study does to participants as well as the academic and practice communities	In-depth analysis, which provides practical information for practitioners and academics alike

Table III Company information

Title	Organization	Type	Sector	Net revenue (billion $)	BDPA's application
Associate Director of Supply Chain	VENCO#1	Vendor	Food & Beverage	15–20	Employing structured use: inventory management Using BDPA for marketing Building a business plan for use Driving supply chain response
Associate Director Customer Development	VENCO#2	Vendor	Snack	30–34	Increasing consumer awareness Waiting for customers Using BDPA for marketing
Associate Director Business Intelligence	VENCO#3	Vendor	Consumer goods	80–90	Analyzing consumer sentiments Using data warehouse (structured only) Using BDPA for marketing
Senior Customer Supply Chain Leader	VENCO#4	Vendor	Household care	1–2	Exploring BDPA use Using BDPA for marketing purposes
Manager: Customer Supply Chain	VENCO#5	Vendor	Packaged Foods	15–20	Internal sharing of structured data Using structured data for S&OP

Team Leader–SC Business Process & Innovation	VENCO#6	Vendor	Household care	7–10	Mapping available structured data Making most of small data
Supply Chain Strategy Manager	VENCO#7	Vendor	Cabinet products	3–5	Playing with data sets
Regional Sales Manager, Business Development	3PLCO#1	3PL	Logistics services	5–10	Optimizing transport Focusing more on segmentation
Director: Retail Sales and Services	3PLCO#2	3PL	Logistics services	5–10	Optimizing transport Focusing more on segmentation
Global Director Retail Solutions	3PLCO#3	3PL	Logistics services	0.20–0.30	Using massive amounts of structured data Analyzing traffic patterns
Strategic Account Manager	3PLCO#4	3PL	Transport services	0.5–1	Driving supply chain response Using structured data only
Chief Strategy and Marketing Officer	3PLCO#5	3PL	Logistics services	0.5–1	Using structured data only
Supply Chain Analyst	RETCO#1	Retailer	Department store	5–10	Using mostly structured data Claiming marketing department looking at BDPA
Vice-President of Supply Chain	RETCO#2	Retailer	Department store	5–10	Using mostly structured data Difficulty integrating data across its RSC
Senior Director of Information Management	RETCO#3	Retailer	General merchandise	Over 100	Leading BDPA initiatives in its RSC Involving cross-functional teams in the initiative

Table IV Representative quotes for concepts

Concept	Representative Quotations
	Organizational context
Operational complexity	"We need to be able to optimize across a complex landscape" "I'd say we are unnecessarily complex. I think we have too many, I think there could be a lot of ways to our organizations, I think we have procedures for procedures' sake"
Supply chain integration	"One other thing that we all need to better understand is when to share this data and getting everyone to share it" "[A] part of it is that because of demand on the supply chain for using that information internally to optimize product flow at a level that it's never been done before" "We see more of a convergence of all of the supply chain systems and tie them together"

	"We are very siloed, with very little integration insofar as what other people do in the company. There is not a lot of visibility"
Top management involvement	"[…]so I in the meantime was bringing this up to the VP of Digital Marketing to say "Hey, do we have interest?" "We need to evaluate cost, opportunities, what would the life opportunity be, what's the ROI opportunities?" "We do things based on what executive management says, and the data may not support it at all." "We do not make any decisions without data to back it up! So even for me, making inventory decisions, if it goes that far, I have to present it to my boss!"
	Human behavior
Decision making for value creation	"It is getting harder and harder to grow our business, so BDPA could help us to identify variations and remove these variations. We really hope it can help us to better understand the root causes of these variations and then be able to do something about it"
Technology design and redesign	"We are attempting to work on unstructured data using social media and […] see if we can make it into more of a structured type of data" "[We] need to have somebody that has a technology background and […] enough business sense to identify the plan of how we're going to use the data"
Inaction	"Personally, I am still struggling with that as a [BDPA] source" "[Our customers] have not worked out what it means to them. And at the end of the day, they are the ones who have to change first"
	BDPA itself
Technological capabilities	"We haven't made that decision to hire people in that area. [W]e have really three people that are tied to WP that are in charge of it. And they're technically very good, but [not adept at] creating and interpreting material that is easy for a layperson to understand" "[Data analysis] expertise is very new; it is very limited"
Data pools	"So, to me, it is just a ton of data that you have to process through" "We go and acquire the data with an objective in mind" "We are not thinking about unstructured data yet; we are just thinking about how to bring in all these data"
Triangulation and validation	"I would define [BDPA] as data from multiple sources that validate each other, that would be either many years of history, multiple levels of hierarchy" "No validation, no clear understanding of how we are going to use it, just that we need to store it. Now we are tapping into the data, and finding a ton of issues with the quality"

Table V Representative quotes for dynamics of the social process of BDPA Use

Organization	*Organizational context affects human behavior*
(RETCO#1)	"[We] do things based on what executive management says, and the data may not support it at all; we have to do it because that is what they have said"
(VENCO#3)	"[C]orporate defines what the strategic choices are from a technology perspective, so they are responsive to me, because [customer name] is very big, so they are responsive to us. If you think of it from a company perspective, the central group, you know, gathers information from a lot of different places and make a strategic decision for the technology. [W]e then deploy it and scaled to all the users"
Organization	*Human behavior affects BDPA*

(3PLCO#1)	"So, I got with Deloitte people and we ran huge data batches to kind of overlay manufacturers, retailers, all these kind of variables, and said, if we put them here at the top, we'll get them where we need them at the bottom to see that view"
(VENCO#3)	"I am an old programmer, so I am fine, but it should be easy for me to write some code to get to the data. But it is obviously not that simple because […] there is a level of complexity that I believe will be wiped away"
(VENCO#4)	"We've also brought in an architect to develop a strategy to synthesize all of our data, so that we didn't have that before, and it was basically a limiter for us"
(3PLCO#1)	"It also has unintended consequences […] we do a lot of things that are ad hoc"
Organization	*BDPA affects human behavior*
(#PLCO#3)	"[…] we can't afford to wait for a system to process [a specific BDPA application] for [a long time]. What we've done is to [either] work with our customers […] so that [we] have more time to complete this or remove this step from the process. Circumnavigating the burdens of batch system […] continue to pose challenges [for us] to live in a real-time world"
(VENCO#4)	"So, it can offer a lot of opportunity to do some hypothesis testing. I preface that with saying that our company needs to get a lot better with medium data before we even look at BDPA"
(VENCO#6)	"As an organization starts to dive deeper into the data and become more analytical, it's essential for the organization not to lose sight of the basics, where the tactical execution meets the customer"
(VENCO#1)	"We have become much smarter and more consumer aware because of [BDPA] and marketing"
(RETCO#2)	"How do I go about tackling it? How do I ensure I'm working with it, my information technology group, to ensure it's arranged or stored in a manner that I can take advantage of it?"
(3PLCO#1)	"[I]n my business, a lot of people sit in an office building and look at a two-dimensional world and then make lots of bold statements about what our customers are doing. Well, a customer-facing person can explain that data in two seconds, and it's completely different"
Organization	*BDPA affects the organizational context*
(VENCO#2)	"[The] challenge is getting everyone on board to think [differently]. In my opinion, [BDPA] is about changing management and getting people to think about how to use the data and how to use multiple data sources differently"
(VENCO#6)	"[We] have had a huge shift from being very operational and tactical to very analytical [driven by data], and that has become a much bigger focus of the corporation"
(VENCO#1)	"I think that the effectiveness of our aftermarket outweighs the efficiency play in the minds of our senior leaders"
(3PLCO#5)	"We need to change our approach from a process-based one to a data-driven one"
(3PLCO#2)	"[We] have a fairly standardized system and historically we've added a lot of value to the supply chain [by imposing our system]. I think we are beginning to be more responsive to the customer now"

Note

1. At informants' request, we disguised organizational names.

References

Aloysius, J.A., Hoehle, H. and Venkatesh, V. (2016), "*Exploiting big data for customer and retailer benefits: a study of emerging mobile checkout scenarios*", International Journal of Operations & Production Management, Vol. 36 No. 4, pp. 467-486.

Arunachalam, D., Kumar, N. and Kawalek, J.P. (2017), "*Understanding big data analytics capabilities in supply chain management: unravelling the issues, challenges and implications for practice*", Transportation Research Part E: Logistics and Transportation Review, Vol. 114, pp. 416-436.

Bostrom, R.P. and Heinen, J.S. (1977), "*MIS problems and failures: a socio-technical perspective, part II: the application of socio-technical theory*", MIS Quarterly, Vol. 1 No. 1, pp. 11-28.

Bowersox, D.J. and Daugherty, P.J. (1995), "*Logistics paradigms: the impact of information technology*", Journal of Business Logistics, Vol. 16 No. 1, pp. 65-75.

Brown, B., Chui, M. and Manyika, J. (2011), "*Are you ready for the era of 'Big Data'?*", McKinsey Quarterly, Vol. 4 No. 1, pp. 24-35.

Chen, D.Q., Preston, D.S. and Swink, M. (2015), "*How the use of big data analytics affects value creation in supply chain management*", Journal of Management Information Systems, Vol. 32 No. 4, pp. 4-39.

Chen, H., Chiang, R.H. and Storey, V.C. (2012), "*Business intelligence and analytics: from Big Data to big impact*", MIS Quarterly, Vol. 36 No. 4, pp. 1165-1188.

Daugherty, P.J. (2011), "*Review of logistics and supply chain relationship literature and suggested research agenda*", International Journal of Physical Distribution & Logistics Management, Vol. 41 No. 1, pp. 77-92.

Daugherty, P.J., Richey, R.G., Genchev, S.E. and Chen, H. (2005), "*Reverse logistics: superior performance through focused resource commitments to information technology*", Transportation Research Part E: Logistics and Transportation Review, Vol. 41 No. 2, pp. 77-92.

Davenport, T.H., Barth, P. and Bean, R. (2012), "*How 'Big Data' is different*", MIT Sloan Management Review, Vol. 54 No. 1, pp. 22-24.

Denk, N., Kaufmann, L. and Carter, C.R. (2012), "*Increasing the rigor of grounded theory research – a review of the SCM literature*", International Journal of Physical Distribution & Logistics Management, Vol. 42 Nos 8/9, pp. 742-763.

DeSanctis, G. and Poole, M.S. (1994), "*Capturing the complexity in advanced technology use: adaptive structuration theory*", Organization Science, Vol. 5 No. 2, pp. 121-147.

Devaraj, S., Krajewski, L. and Wei, J.C. (2007), "*Impact of ebusiness technologies on operational performance: the role of production information integration in the supply chain*", Journal of Operations Management, Vol. 25 No. 6, pp. 1199-1216.

Drazin, R. and Van de Ven, A. (1985), "*Alternative forms of fit in contingency theory*", Administrative Science Quarterly, Vol. 30 No. 1, pp. 514-539.

Eason, K.D. (2014), Information Technology and Organisational Change, CRC Press, London.

Eisenhardt, K.M. and Martin, J.A. (2000), "*Dynamic capabilities: what are they?*", Strategic Management Journal, Vol. 21 Nos 10/11, pp. 1105-1121.

Fisher, M. and Raman, A. (2018), "*Using data and big data in retailing*", Production and Operations Management, forthcoming.

Flynn, B.B., Koufteros, X. and Lu, G. (2016), "*On theory in supply chain uncertainty and its implications for supply chain integration*", Journal of Supply Chain Management, Vol. 52 No. 3, pp. 3-27.

Fugate, B.S., Flint, D.J. and Mentzer, J.T. (2008), "*The role of logistics in market orientation*", Journal of Business Logistics, Vol. 29 No. 2, pp. 1-26.

Gammelgaard, B. and Flint, D. (2012), "*Qualitative research in logistics and supply chain management: beyond the justification for using qualitative methods*", International Journal of Physical Distribution & Logistics Management, Vol. 42, Nos 8/9, p. 42.

Garud, R. and Van De Ven, A.H. (1992), "*An empirical evaluation of the internal corporate venturing process*", Strategic Management Journal, Vol. 13 No. S1, pp. 93-109.

Gehman, J., Glaser, V.L., Eisenhardt, K.M., Gioia, D., Langley, A. and Corley, K.G. (2018), "*Finding theory-method fit: a comparison of three qualitative approaches to theory building*", Journal of Management Inquiry, Vol. 27 No. 3, pp. 284-300.

Germain, R., Claycomb, C. and Dröge, C. (2008), "*Supply chain variability, organizational structure, and performance: the moderating effect of demand unpredictability*", Journal of Operations Management, Vol. 26 No. 5, pp. 557-570.

Ghoshal, S. and Bartlett, C.A. (1994), "*Linking organizational context and managerial action: the dimensions of quality of management*", Strategic Management Journal, Vol. 15 No. 2, pp. 91-112.

Gioia, D.A., Corley, K.G. and Hamilton, A.L. (2013), "*Seeking qualitative rigor in inductive research: notes on the Gioia methodology*", Organizational Research Methods, Vol. 16 No. 1, pp. 15-31.

Glaser, B. and Strauss, A. (2017), "*The discovery grounded theory: strategies for qualitative research*", Routledge.

Grover, V. and Kohli, R. (2012), "*Cocreating IT value: new capabilities and metrics for multifirm environments*", MIS Quarterly, Vol. 36 No. 1, pp. 225-232.

Gunasekaran, A., Papadopoulos, T., Dubey, R., Wamba, S.F., Childe, S.J., Hazen, B. and Akter, S. (2017), "*Big data and predictive analytics for supply chain and organizational performance*", Journal of Business Research, Vol. 70 No. 1, pp. 308-317.

Hambrick, D.C. and Schecter, S.M. (1983), "*Turnaround strategies for mature industrial-product business units*", Academy of Management Journal, Vol. 26 No. 2, pp. 231-248.

Hardgrave, B.C., Aloysius, J.A. and Goyal, S. (2013), "*RFID-enabled visibility and retail inventory record inaccuracy: experiments in the field*", Production and Operations Management, Vol. 22 No. 4, pp. 843-856.

Hazen, B.T., Boone, C.A., Ezell, J.D. and Jones-Farmer, L.A. (2014), "*Data quality for data science, predictive analytics, and big data in supply chain management: an introduction to the problem and suggestions for research and applications*", International Journal of Production Economics, Vol. 154 No. 1, pp. 72-80.

Jarvenpaa, S.L. and Ives, B. (1993), "*Organizing for global competition: the fit of information technology*", Decision Sciences, Vol. 24 No. 3, pp. 547-580.

Jin, Y.H., Swanson, D., Waller, M. and Ozment, J. (2017), "*To survive and thrive under hypercompetition: an exploratory analysis of the influence of strategic purity on Truckload motor-carrier financial performance*", Transportation Journal, Vol. 56 No. 1, pp. 1-34.

Jin, Y.H., Williams, B.D., Tokar, T. and Waller, M.A. (2015), "*Forecasting with temporally aggregated demand signals in a retail supply chain*", Journal of Business Logistics, Vol. 36 No. 2, pp. 199-211.

Jin, Y.H., Williams, B.D., Waller, M.A. and Hofer, A.R. (2015), "*Masking the bullwhip effect in retail: the influence of data aggregation*", International Journal of Physical Distribution & Logistics Management, Vol. 45 No. 8, pp. 814-830.

Karahanna, E., Straub, D.W. and Chervany, N.L. (1999), "*Information technology adoption across time: a cross-sectional comparison of pre-adoption and post-adoption beliefs*", MIS Quarterly, Vol. 23 No. 1, pp. 183-213.

Kurnia, S., Choudrie, J., Mahbubur, R.M. and Alzougool, B. (2015), "*E-commerce technology adoption: a Malaysian grocery SME retail sector study*", Journal of Business Research, Vol. 68 No. 9, pp. 1906-1918.

Langley, A. and Abdallah, C. (2011), "Templates and turns in qualitative studies of strategy and management", Building Methodological Bridges, Emerald Group Publishing, pp. 231-235.

LaValle, S., Lesser, E., Shockley, R., Hopkins, M.S. and Kruschwitz, N. (2011), "*Big data, analytics and the path from insights to value*", MIT Sloan Management Review, Vol. 52 No. 1, pp. 21-32.

Lincoln, Y.S. and Guba, E.G. (1985), Naturalistic Inquiry, Sage Publications, London.

McAfee, A., Brynjolfsson, E., Davenport, T.H., Patil, D. and Barton, D. (2012), "*Big Data: the management revolution*", Harvard Business Review, Vol. 90 No. 10, pp. 61-67.

McCracken, G. (1988), The Long Interview, Sage Publications, Thousand Oaks, CA and London.

Manuj, I. and Pohlen, T.L. (2012), "*A reviewer's guide to the grounded theory methodology in logistics and supply chain management research*", International Journal of Physical Distribution & Logistics Management, Vol. 42 Nos 8/9, pp. 784-803.

Markus, M.L. and Robey, D. (1988), "*Information technology and organizational change: causal structure in theory and research*", Management Science, Vol. 34 No. 5, pp. 583-598.

Marr, B. (2017), "*Really Big Data at walmart: real-time insights from their 40+ petabyte data cloud*", Wall Street Journal, January 1, available at: https://forbes.com/sites/bernardmarr/2017/01/23/really-big-data-at-walmart-real-time-insights-from-their-40-petabyte-data-cloud

Mello, J. and Flint, D.J. (2009), "*A refined view of grounded theory and its application to logistics research*", Journal of Business Logistics, Vol. 30 No. 1, pp. 107-125.

Mukhopadhyay, T., Kekre, S. and Kalathur, S. (1995), "*Business value of information technology: a study of electronic data interchange*", MIS Quarterly, Vol. 19 No. 1, pp. 137-156.

Orlikowski, W.J. (1992), "*The duality of technology: rethinking the concept of technology in organizations*", Organization Science, Vol. 3 No. 3, pp. 398-427.

Pagell, M. and Krause, D.R. (2004), "*Re-exploring the relationship between flexibility and the external environment*", Journal of Operations Management, Vol. 21 No. 6, pp. 629-649.

Papadopoulos, T., Gunasekaran, A., Dubey, R. and Fosso Wamba, S. (2017), "*Big data and analytics in operations and supply chain management: managerial aspects and practical challenges*", Production Planning & Control, Vol. 28 Nos 11/12, pp. 873-876.

Pettigrew, A. (1990), "*Longitudinal field research on change: theory and practice*", Organization Science, Vol. 1 No. 3, pp. 267-292.

Pfeffer, J. and Salancik, G. (1978), The External Control of Organizations: A Resource Dependence Perspective, Harper & Row, New York, NY.

Premkumar, G., Ramamurthy, K. and Saunders, C. (2005), "*Information processing view of organizations: an exploratory examination of fit in the context of interorganizational relationships*", Journal of Management Information Systems, Vol. 22 No. 1, pp. 257-294.

Purvis, R.L., Sambamurthy, V. and Zmud, R.W. (2001), "*The assimilation of knowledge platforms in organizations: an empirical investigation*", Organization Science, Vol. 12 No. 2, pp. 117-135.

Randall, W.S. and Mello, J.E. (2012), "*Grounded theory: an inductive method for supply chain research*", International Journal of Physical Distribution & Logistics Management, Vol. 42 Nos 8/9, pp. 863-880.

Richey, R.G., Morgan, T.M., Hall, K.L. and Adams, F.G. (2016), "*A global exploration of big data in the supply chain*", International Journal of Physical Distribution & Logistics Management, Vol. 46 No. 8, pp. 710-739.

Saldanha, J.P., Mello, J.E., Knemeyer, A.M. and Vijayaraghavan, T. (2015), "*Implementing supply chain technologies in emerging markets: an institutional theory perspective*", Journal of Supply Chain Management, Vol. 51 No. 1, pp. 5-26.

Sanders, N.R. (2016), "*How to use big data to drive your supply chain*", California Management Review, Vol. 58 No. 3, pp. 26-48.

Schoenherr, T. and Speier-Pero, C. (2015), "*Data science, predictive analytics, and big data in supply chain management: current state and future potential*", Journal of Business Logistics, Vol. 36 No. 1, pp. 120-132.

Suddaby, R. (2006), "From the editors: what grounded theory is not", Academy of Management Journal, Vol. 49 No. 4, pp. 633-642.

Swanson, D., Jin, Y.H., Fawcett, A.M. and Fawcett, S.E. (2017), "*Collaborative process design: a dynamic capabilities view of mitigating the barriers to working together*", The International Journal of Logistics Management, Vol. 28 No. 2, pp. 571-599.

Tallon, P.P., Kraemer, K.L. and Gurbaxani, V. (2000), "*Executives' perceptions of the business value of information technology: a process-oriented approach*", Journal of Management Information Systems, Vol. 16 No. 4, pp. 145-173.

Trist, E. (1981), "*The evolution of socio-technical systems*", Occasional paper, 2, No. 1, pp. 1967-1981.

Van Maanen, J. (1979), "*The fact of fiction in organizational ethnography*", Administrative Science Quarterly, Vol. 24 No. 4, pp. 539-550.

Venkatesh, V. and Davis, F.D. (2000), "*A theoretical extension of the technology acceptance model: four longitudinal field studies*", Management Science, Vol. 46 No. 2, pp. 186-204.

Waller, M.A. and Fawcett, S.E. (2013), "*Click here for a data scientist: big data, predictive analytics, and theory development in the era of a maker movement supply chain*", Journal of Business Logistics, Vol. 34 No. 4, pp. 249-252.

Walsham, G. (2006), "*Doing interpretive research*", European Journal of Information Systems, Vol. 15 No. 3, pp. 320-330.

Wamba, S.F., Gunasekaran, A., Akter, S., Ren, S.J.-f., Dubey, R. and Childe, S.J. (2017), "*Big data analytics and firm performance: effects of dynamic capabilities*", Journal of Business Research, Vol. 70 No. 1, pp. 356-365.

Wang, R.Y. and Strong, D.M. (1996), "*Beyond accuracy: what data quality means to data consumers*", Journal of Management Information Systems, Vol. 12 No. 4, pp. 5-33.

Williams, R. and Edge, D. (1996), "*The social shaping of technology*", Research Policy, Vol. 25 No. 6, pp. 865-899.

Zucker, L. (1987), "*Institutional theories of organization*", Annual Review of Sociology, Vol. 13 No. 1, pp. 443-464.

Further reading

Hazen, B.T., Overstreet, R.E. and Cegielski, C.G. (2012), "*Supply chain innovation diffusion: going beyond adoption*", The International Journal of Logistics Management, Vol. 23 No. 1, pp. 119-134.

Mackelprang, A.W., Robinson, J.L., Bernardes, E. and Webb, G.S. (2014), "*The relationship between strategic supply chain integration and performance: a meta-analytic evaluation and implications for supply chain management research*", Journal of Business Logistics, Vol. 35 No. 1, pp. 71-96.

Supplementary materials

IJPDLM_49_7.pdf (12 MB)