Understanding the nature of processes: an information-processing perspective

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Received 20 May 2016
Revised 22 August 2016
8 October 2016
11 December 2016
Accepted 8 January 2017

Abstract

Purpose – While researchers and practitioners agree on the importance to adapt business process management (BPM) practices to the nature of processes, the authors observe a lack of research on how to most meaningfully distinguish processes in order to apply context-specific BPM practices that increase process efficiency and effectiveness. The purpose of this paper is to systematically analyze the nature of processes as one contextual factor for BPM.

Design/methodology/approach – Based on a literature review, the authors systematically derive process dimensions that describe the nature of processes and apply an information-processing perspective to the process level as a theoretical lens through which to analyze and structure these process dimensions.

Findings – The authors identified 36 dimensions used to describe process differences that can be consolidated into five generic dimensions based on an information-processing perspective: interdependence of process participants, differentiation of process participants, process analyzability, variability, and importance.

Research limitations/implications – The paper derives process dimensions from the literature and links them to extant theories as a foundation for context-sensitive BPM. The findings serve as a basis for further conceptualizing BPM and for explaining seemingly contradicting findings about whether management practices increase or decrease organizational performance.

Practical implications – While the paper focuses on understanding and explaining process differences, the authors also demonstrate how these dimensions can be used to make strategic management decisions in order to increase the effectiveness and efficiency of processes.

Originality/value – The authors systematically conceptualize process differences as a foundation for contingent process management. In addition, the authors demonstrate that organizational processes provide a new field of application for information-processing theory.

Keywords Uncertainty, Process management, Contingency theory, Information gathering

Paper type Literature review

1. Introduction

Business process management (BPM) is an approach to increasing transparency, reducing costs, harmonizing processes, improving quality, and enhancing customer satisfaction (BearingPoint, 2015). It includes the identification and documentation of business processes, the definition of key performance indicators for measuring and monitoring process performance, and the implementation of continuous improvement and innovation (Lee and Dale, 1998).

However, many process-management initiatives do not have the expected results, at least in part because of the failure to consider the contextual factors that can determine a management practice's success (Benner and Tushman, 2003; Trkman, 2010). Four contextual factors have been identified for a BPM initiative: its goal, organizational factors, environmental factors, and process characteristics (vom Brocke *et al.*, 2016). As most research has examined the influence of environmental and organizational factors (Trkman, 2010; Rosemann *et al.*, 2008), the focus of this paper is to identify process characteristics systematically in order to understand the nature of processes as a contextual factor in BPM.

Organizational processes range from automated and mass-customized processes (Feitzinger and Lee, 1997) to artistic, knowledge-intensive, or creative processes (Hall and Johnson, 2009; Davenport, 2010; Seidel *et al.*, 2015). These kinds of process characteristics should be considered when managing processes, such as when virtualizing or standardizing them (e.g. Overby, 2008; Schaefermeyer *et al.*, 2010, 2012; Hall and Johnson, 2009).

Business Process Management Journal
Vol. 24 No. 1, 2018
pp. 67-88

1463-7154
DOI 10.1108/BPMJ-05-2016-0102

For example, a highly structured process in the Human Resources department in which compliance plays an important role, such as the creation of employees' contracts, is likely to entail detailed process documentation, and compliance is likely to be closely monitored. On the other hand, a strategic process like developing the next product strategy requires less documentation or measurement of compliance.

To date, we observe a lack of research on how organizational processes differ and how we can apply extant theories to better understand process differences. Although some process-classification systems have been developed that differentiate among the types of processes, such as core, management, and support processes (Ould, 1995) or primary and secondary activities (Porter, 1995), these systems differentiate processes only on an abstract level, so they cannot explain why a certain process requires a certain management approach. In addition, these classification systems are broad in that they differentiate only among a few types of processes without specifying the underlying dimensions on which processes can differ. This is, however, a prerequisite for a contingent process-management research and practice that considers the nature of processes as a contextual factor (Zeithaml *et al.*, 1988).

This paper intends to close this gap in the literature and systematically develops a classification system so future BPM research can be more sensitive to context, thereby increasing the efficiency and effectiveness of process-management initiatives.

Therefore, the general research question of our paper refers to understanding how (on which dimensions) processes differ and links this understanding to extant theories as a basis for contingent process management. In answering this question, we follow Bailey's (1994) and Nickerson *et al.* (2013) view that the identification of critical dimensions should build on prior knowledge and theoretical guidance, so we conduct a structured literature review following established approaches (vom Brocke *et al.*, 2009; Webster and Watson, 2002) to derive process dimensions from the literature. As processes can be viewed as information-processing systems (Mani *et al.*, 2010), we used the information-processing theory (Galbraith, 1973; Haußmann *et al.*, 2010) as a theoretical lens through which to analyze the results of the literature review and propose process dimensions.

Our paper contributes to the body of knowledge in the field of process management and information-processing theory in three primary ways: first, we conceptualize process dimensions that help to clarify and describe how processes in organizations can differ. These dimensions can serve, for example, as moderating variables that explain opposing findings about whether BPM practices increase or decrease organizational performance (Benner and Tushman, 2003). Second, an understanding of the differences in processes facilitates the improvement of process-management practices. Based on an understanding of the differences in their processes, researchers and practitioners can develop and apply management practices that help them make informed decisions and prevent wasted efforts (Venkatesh, 2006; Schaefermeyer *et al.*, 2010, 2012; Rosenkranz *et al.*, 2010), thereby increasing the efficiency and effectiveness of BPM. Third, we demonstrate to what extent an information-processing perspective can be applied to the level of organizational processes to help clarify the differences in processes and explain their management requirements. Thus, our paper provides a new field of application for information-processing theory.

The remainder of the paper is structured as follows. We start by introducing the main concepts of our research and the theoretical lens we applied to analyze differences in processes. We then describe the methodological approach and present the findings of the literature review, which we analyze using an information-processing perspective. Next, we illustrate how organizational processes can be evaluated based on our findings and how doing so can affect process-management research and practice. The paper concludes with implications, limitations, and suggestions for further research.

2. Related work

2.1 Research on process management

Process-management research, which evolved out of the quality movement (e.g. total quality management, Six Sigma) and radical redesign approaches (e.g. business process re-engineering) (Hammer, 2015), includes the design, implementation, monitoring, and continuous improvement of organizational processes to improve performance in areas like production time, customer satisfaction, quality, and costs (Kohlbacher, 2010). Process-management practices are often inspired by the logic related to processes investigated in the early stages of BPM, such as production, logistics, and administrative processes – all of which are well-structured and supported by or operated through application systems (Hammer, 2015; Harmon, 2015). Today, however, BPM is applied in a greater diversity of processes, including managerial, innovation and strategic-planning processes (e.g. Gassmann, 2006; Puiu *et al.*, 2009).

Recent developments in BPM research have shown that process-management approaches now take a holistic view, focusing not only on "hard" factors like information technology (IT) but also on "soft" factors like people and culture (De Bruin and Rosemann, 2004; vom Brocke and Sinnl, 2011). On the other hand, because of the increasing numbers of application fields for BPM, the contextual factors of BPM have become important (vom Brocke *et al.*, 2016; Tachizawa and Yew Wong, 2014; Clegg and Wan, 2013; Danese and Romano, 2011; Huang *et al.*, 2014). According to contingency theory (Donaldson, 2001), contextual factors can be external to BPM, such as organizational and environmental factors, or internal to BPM, such as the goal of BPM and the characteristics of the processes under investigation (vom Brocke *et al.*, 2016).

Our study systematically examines the factors that are related to the process itself (i.e. its characteristics), as processes in the same organization can have diverse management requirements while being subject to the same organizational and environmental factors. For example, structured, administrative processes have process-management requirements that differ from those of creative, knowledge-intensive processes, even though they occur in the same organization. Many researchers support the need to take the characteristics of a process into consideration when deciding how to manage it. For example, the success of process-standardization initiatives depends on the nature of the processes to be standardized (Rosenkranz *et al.*, 2010; Schaefermeyer *et al.*, 2012). Determining which processes can be standardized requires a systematic understanding of the processes' characteristics (Schaefermeyer *et al.*, 2010; Venkatesh, 2006).

2.2 Research on types and dimensions of processes

Researchers have developed classification systems to describe the differences between processes (for an overview, see Vilkas and Stancikas, 2005). A well-known classification of processes differentiates among management, core, and support processes (Sousa *et al.*, 2011; Duan *et al.*, 2009; Hammer, 2015), where core processes have a direct impact on customers, support processes enable core processes to work effectively, and management processes are strategic processes focusing on goals, monitoring, and control. A similar classification system from business and economic research is Porter's (1995) value chain model, which distinguishes between primary activities like inbound logistics, operations, outbound logistics, marketing, sales, and services, and secondary activities like infrastructure, human resources, technology, and procurement. Primary activities resemble core processes, while secondary activities are similar to support processes.

These process-classification systems are helpful for organizations, as they reduce complexity and provide an overview of the kinds of processes that constitute an organization. However, the categories that have been proposed are too broad to contribute to the effective and efficient management of a wide range of work processes. For example, core processes consist of a variety of processes that differ structurally, including those that are

"artistic" (Hall and Johnson, 2009), "creative" (Seidel *et al.*, 2015), "mass-customized" (Feitzinger and Lee, 1997), "machine-intensive," or "automated" (Schmahl, 1996; Feitzinger and Lee, 1997). A contingent process-management approach should require consideration of the underlying process dimensions instead of a blunt classification into core vs support processes, for example. In short, existing classification systems used to characterize processes according to management requirements do not address the diversity of processes adequately.

Therefore, if organizations are to manage their processes efficiently and effectively, they must understand the differences among processes not only by distinguishing among types of processes but also by describing on which dimensions these processes differ. We define process dimensions as dimensions that can be used to describe their nature in a differentiated way. Researchers mention only single process dimensions, such as the degree of structuredness (Papavassiliou and Mentzas, 2003; Isik *et al.*, 2013), interdependence (Setia *et al.*, 2013; Davenport, 2010), or creativity (Isik *et al.*, 2013; Eppler *et al.*, 1999), but to our knowledge none have provided a systematic list of process dimensions as a basis for determining the process-management approach that is most likely to be successful.

3. Theoretical foundation

The need to differentiate process-management research and practice based on contextual factors, such as process characteristics, is supported by contingency theory (Morgan, 2007; Donaldson, 2001), which states that there is no best way to organize and manage people, tasks, technologies, or structures, but that the optimal way depends on context. A contingency approach to process management requires identifying the process's relevant contextual factors and deriving appropriate management requirements that fit the situation (Zeithaml *et al.*, 1988).

Organizational information-processing theory (OIPT) conceptualizes the lack of fit between contextual factors and management practices as a gap between information-processing requirements and information-processing capacity (Tushman and Nadler, 1978; Galbraith, 1973; Daft and Lengel, 1986; Haußmann *et al.*, 2010). OIPT assumes that organizations are information-processing systems that deal with uncertainty based on the size of the gap between information-processing requirements and information-processing capacity. Organizations try to close this gap through various coordination and control mechanisms (e.g. rules and defined procedures, hierarchy, information systems). While OIPT's unit of analysis is the organization, it can also refer to lower levels, such as work units (Daft and Lengel, 1986) and business processes (Mani *et al.*, 2006, 2010).

Researchers who apply an information-processing perspective seek to determine what factors influence an entity's (e.g. organization, unit, process) information-processing requirements and capacity. Several task and process characteristics can determine the information-processing requirements (Galbraith, 1973; Daft and Lengel, 1986; Tushman and Nadler, 1978), including analyzability (the degree to which people can follow objective, computational procedures), variability (the frequency of unexpected and novel events that occur in the conversion process), interdependence (the degree to which an entity depends on others in accomplishing a task), differentiation (the extent to which people with different experiences and goals are involved), and importance (the degree to which a task or process impacts an organization's competitiveness). An information-processing perspective follows a contingency view in that management approaches must be selected based on the characteristics of the task or process to be managed.

Processes can be seen as open social systems that interact with each other and with their environments (Melão and Pidd, 2000), so an information-processing perspective informs the systematic understanding of differences in processes that we develop within this paper. Contingency theory and OIPT in particular support the need for a contingent management approach that considers the characteristics of processes, so OIPT serves as the theoretical lens through which to clarify differences in processes.

4. Methodological approach

We build on well-established methods for developing classification systems in deriving the process dimensions that help to clarify differences in processes and to determine optimum process-management practices (Bailey, 1994; Nickerson *et al.*, 2013). We identify peer-reviewed articles that address the topic of differences in processes through a search in databases, Emerald and Proquest, which are typically consulted for literature reviews in the process-management field (Burgess *et al.*, 2006; De Jong and Vermeulen, 2003). We searched abstracts and titles using the search terms "process characteristic*," "process type*," "process dimension*," "process nature*," "characteristic* of process*," "type* of process*," "dimension* of process*," and "nature* of process*." These terms increase the likelihood of identifying articles that either address specific types of processes or describe process characteristics, structures, or nature.

The search for peer-reviewed journal articles resulted in 603 hits, most from the terms "process characteristic*" and "type* of process*." We read the articles' abstracts and eliminated 438 articles from research areas like chemistry, biology, chemical engineering, and politics, because "process," as used in these areas of study, tends to be unrelated to the dimensions of work/business processes.

We examined the 165 remaining articles for their relevance to the research topic at hand and excluded 102 articles that included only related words (e.g. "processing," "processual") and did not focus on business or work processes or that focused less on differences in processes than on types of process improvements, process controls, or process industries. These two rounds left 63 articles for our review. Table I summarizes the number of hits and the articles selected per search term and per database.

Among the 60 unique articles (three articles were identified by both databases), one article provided an overview of 12 additional articles that mentioned the dimensions of processes (Isik *et al.*, 2013), so these articles were added, leading to a final number of 72 articles for our review. The selected articles, all of which were published between 1976 and 2013, focus on topics like BPM, supply chain management, quality management, manufacturing, and organizational learning or on specific processes, such as service processes, manufacturing processes, or public administration processes.

We searched the 72 articles' full text for words mentioned in relation to processes. For example, from the statement "achieving the process improvements necessary for pollution prevention is challenging due to the inherent complexity and unpredictability of several types of processes" (Rajaram and Corbett, 2002), we derived the dimensions "complexity" and "predictability." This effort resulted in 70 terms. Similar to the approach of Terrion and Leonard (2007), who derived and grouped the characteristics of student peer mentors from

Search term	Proquest number of hits (number of selected articles)	Emerald number of hits (number of selected articles)	Overall number of hits (number of selected articles)
"process characteristic*"	153 (21)	0 (0)	153 (21)
"process type*"	74 (15)	7 (4)	81 (19)
"process dimension*"	73 (5)	1 (1)	74 (6)
"process nature*"	13 (2)	1 (0)	14 (2)
"characteristic* of process*"	16 (0)	0 (0)	16 (0)
"type* of process*"	230 (10)	0 (0)	230 (10)
"dimension* of process*"	12 (2)	0 (0)	12 (2)
"nature* of process*"	23 (3)	0 (0)	23 (3)
Overall	594 (58)	9 (5)	603 (63)

Table I. Overview of literature search approach and related results

the literature, we went through the list to eliminate obvious overlaps. For example, we grouped "information degree" to the dimension "information intensity," as both characteristics describe the amount of information that is required to execute a process, and we grouped "output heterogeneity," "product variety," "number of products," and "range of service offerings" into the general category "variety of outputs," as all describe the diversity or variety of products and services. Terms that differentiated core and support processes were summarized to the underlying dimension "value contribution," as core and support processes differ in the amount of value they create.

5. Results

5.1 Identifying process dimensions

Based on our literature review, we derived 36 process dimensions, which are listed in Table II. The most frequently mentioned dimension refers to a process's level of complexity ($n = 21$). Other frequently mentioned dimensions were the degree of customization ($n = 9$), the degree of the predictability of a process's tasks or outcomes ($n = 8$), and the level to which the process is structured ($n = 8$), which characterizes processes as "well structured" or "less structured." The degree of automation, creativity, customer involvement, and frequency is also mentioned repeatedly ($n = 7$).

Some of the dimensions listed in Table II overlap or are closely related to other process dimensions. For example, a process' complexity summarizes some of the other process dimensions: complex processes are often non-routine (Tushman and Nadler, 1978) or require interpretation or personal judgment (Davenport, 2010). Similarly, the degree of customization can be the opposite of a process' degree of standardization (Safizadeh *et al.*, 1999). Thus, the list of process dimensions has the potential for additional consolidation.

5.2 Consolidating process dimensions based on an information-processing perspective

To derive and consolidate process dimensions, it is important to build not only on prior knowledge but also on theoretical guidance (Bailey, 1994; Nickerson *et al.*, 2013). Therefore, we use OIPT as a theoretical lens to consolidate the findings of the literature review, to link the review to extant theories, and to structure our findings. We selected the theory for several reasons: first, processes, like organizations, are information-processing systems that require the collection, use, and distribution of information (Mani *et al.*, 2006, 2010). Second, OIPT follows a contingency approach, suggesting that management requirements need to be adapted to contextual factors, including process characteristics. Third, OIPT is helpful in clarifying differences in processes, as it postulates information-processing requirements based on the processes' characteristics.

The first dimension that research in the field of information-processing theory often applies is interdependence, which refers to the degree to which people depend on others to accomplish a task (Tushman and Nadler, 1978; Daft and Lengel, 1986; Mani *et al.*, 2010). Interdependence has also been conceptualized by other researchers, some of whom contrast interdependence with autonomy, while others contrast sequential, reciprocal, and collaborative processes as levels of interdependence (Thompson, 1967; Davenport, 2010). Our literature review identified several process characteristics that are related to this dimension, such as the interdependence between functional units or tasks, the degree of collaboration, and the iterativeness or linearity of the process. Similarly, the boundaries of a process describe whether a process is performed in one team or crosses teams, departments, functions, or even organizations; the more people or departments involved, the higher the interdependence of process participants. We could consolidate all these dimensions into the general interdependence of the process.

Another task or process characteristic that OIPT suggests is variability, which refers to the frequency of unexpected and novel events (Van de Ven and Delbecq, 1974). When the

Process dimension	Source (authors)	Frequency
Automation	Rajaram and Corbett (2002), Vargas and Johnson (1992), Isik *et al.* (2013), Brownell and Merchant (1990), Subramaniam and Shaw (2004), Davenport (2010), Marjanovic and Freeze (2011)	7
Boundaries	Gibb *et al.* (2006), Segars and Grover (1998)	2
Collaboration	Teng *et al.* (1994), Cho (2006), Nadia *et al.* (2006), Griffin (1997), Davenport (2010)	5
Complexity	Helkiö and Tenhiälä (2013), Rajaram and Corbett (2002), Vargas and Johnson (1992), Hagras *et al.* (1999), Bala and Venkatesh (2013), Tenhiälä (2011), Al-Sudairi (2007), Harrison (1998), Setia *et al.* (2013), Stremtan *et al.* (2009), Isik *et al.* (2013), Papavassiliou *et al.* (2003), Lau *et al.* (2002), Bala (2013), Subramaniam and Shaw (2004), Ahire and Dreyfus (2000), Davenport (2010), Eppler *et al.* (1999), Harmon (2007), Kulkarni and Ipe (2007), Marjanovic and Freeze (2011)	21
Consistency	Davenport (2010)	1
Creativity	Isik *et al.* (2013), Eppler *et al.* (1999), Kulkarni and Ipe (2007), Marjanovic and Freeze (2011), Marjanovic and Seethamraju (2008), Richter-Von Hagen *et al.* (2005), Sarnikar and Deokar (2010)	7
Criticality	Gebauer and Lee (2008)	1
Customer involvement	Kellogg and Nie (1995), Safizadeh *et al.* (1999), Harrison (1998), Groenroos (1998), Mackelprang *et al.* (2012), Silvestro *et al.* (1992), Field *et al.* (2006)	7
Customer type	Gibb *et al.* (2006), Field *et al.* (2006)	2
Customization	Slaughter *et al.* (2006), Safizadeh *et al.* (1999), Cho (2006), Kallio *et al.* (2000), Rosen and Karwan (1994), Victorino *et al.* (2013), Mackelprang *et al.* (2012), Silvestro *et al.* (1992), Field *et al.* (2006)	9
Flexibility	Chou *et al.* (2010), Helkiö and Tenhiälä (2013), Papavassiliou and Mentzas (2003)	3
Formalization	Varela and Benito (2005), Segars and Grover (1998), Griffin (1997), Davenport (2010)	4
Information intensity	Setia *et al.* (2013), Gibb *et al.* (2006)	2
Interdependence between functional units/tasks	Setia *et al.* (2013), Fang (2011), Davenport (2010), Ma *et al.* (2012), Tenhiälä (2011), Sprigg *et al.* (2000)	6
Knowledge intensity	Papavassiliou and Mentzas (2003), Papavassiliou *et al.* (2003), Isik *et al.* (2013)	3
Iterativeness	Davenport (2010)	1
Labor intensity	Vargas and Johnson (1992), Rosen and Karwan (1994), Mackelprang *et al.* (2012)	3
Linearity	Hagras *et al.* (1999)	1
Number of process participants	Field *et al.* (2006)	1
Personal judgment/ thinking/interpretation	Lillrank (2003), Davenport (2010)	2
Predictability	Rajaram and Corbett (2002), Isik *et al.* (2013), Field *et al.* (2006), Eppler *et al.* (1999), Kulkarni and Ipe (2007), Marjanovic and Freeze (2011), Richter-Von Hagen *et al.* (2005), Swenson and Palmer (2010)	8
Process time/duration	Field *et al.* (2006)	1
Repeatability	Isik *et al.* (2013), Lillrank (2003), Davenport (2010), Marjanovic and Freeze (2011), Swenson and Palmer (2010)	5
Repetitiveness	Vargas and Johnson (1992), Tenhiälä (2011), Roe (1988), Hanna *et al.* (2000)	4
Rigidity	Bala and Venkatesh (2013), Varela and Benito (2005), Bala (2013), Papavassiliou and Mentzas (2003)	4
Routinization	Setia *et al.* (2013), Rosen and Karwan (1994), Hofstede (1978), Lillrank (2003)	4

(*continued*)

Table II.
Process dimensions derived from the literature

Process dimension	Source (authors)	Frequency
Spontaneity (ad hoc vs predefined)	Harrison (1998), Papavassiliou and Mentzas (2003)	2
Standardization	Slaughter *et al.* (2006), Vargas and Johnson (1992), Johansson and Olhager (2006), Kallio *et al.* (2000), Victorino *et al.* (2013)	5
Structuredness	Papavassiliou and Mentzas (2003), Papavassiliou *et al.* (2003), Isik *et al.* (2013), Davenport (2010), Harmon (2007), Marjanovic and Freeze (2011), Marjanovic and Seethamraju (2008), Richter-Von Hagen *et al.* (2005)	8
Type of output (tangibility, discreteness)	Kellogg and Nie (1995), Komashie *et al.* (2007), Field *et al.* (2006), French and LaForge (2006)	4
Uncertainty	Gebauer and Lee (2008), Setia *et al.* (2013), Sprigg *et al.* (2000)	3
Value contribution	Gibb *et al.* (2006), Duan *et al.* (2009), Rodríguez-Díaz and Espino-Rodríguez (2006), Harrison (1998), Vanhaverbeke and Torremans (1999)	5
Variability	Gebauer and Lee (2008), Harrison (1998), Mackelprang *et al.* (2012)	3
Variety of inputs	Lillrank (2003)	1
Variety of outputs	Johansson and Olhager (2006), Harrison (1998), Silvestro *et al.* (1992), Field *et al.* (2006), Slaughter *et al.* (2006), Safizadeh *et al.* (1999)	6
Volume/frequency	Slaughter *et al.* (2006), Vargas and Johnson (1992), Harrison (1998), Johansson and Olhager (2006), Subramaniam and Shaw (2004), Silvestro *et al.* (1992), Segars and Grover (1998)	7

Table II.

variability of tasks in a process is high, the number of process exceptions and deviations are also high (Mani *et al.*, 2010). Research articles have applied the concept of variability in a number of ways, defining it as variety (Daft and Lengel, 1986), routineness (Tushman and Nadler, 1978; Goodhue *et al.*, 1992), uniformity (Mohr, 1971), predictability (Galbraith, 1973), repetitiveness, and rigidity (Van de Ven and Delbecq, 1974). Overall, the items used to measure this construct refer to the variability or dissimilarity of work activities from one process instance to another (Whitey *et al.*, 1983; Daft and Macintosh, 1981; Mani *et al.*, 2010). Our literature review identified many dimensions that describe the amount of uniformity (doing things in the same, standard way) or the amount of dissimilarity (doing things differently). For uniformity, example process dimensions are consistency, predictability, repeatability, repetitiveness, structuredness, rigidity, routinization, and standardization. For dissimilarity, example process dimensions are customization, flexibility, and variety of inputs and outputs. Thus, also variability seems to consolidate many of the process dimensions identified in the literature review.

Analyzability describes the extent to which tasks or processes requires objective, computational procedures as opposed to personal judgment and experience (Daft and Lengel, 1986; Haußmann *et al.*, 2010). Our literature review showed process dimensions which are similar to this definition. On the one hand, dimensions such as automation and formalization describe processes with objective, computational procedures. On the other hand, dimensions such as personal judgment, knowledge intensity, and creativity describe the opposite thus the amount of personal judgment and experience that is required to execute the process. Also the analyzability dimension shows overlaps with many of the process dimensions from our literature review.

Three other characteristics identified in our literature review can be consolidated through OIPT's differentiation dimension: the number of participants in a process, labor intensity, and customer involvement. Differentiation describes the degree to which people with differing backgrounds, experience, goals, and priorities are involved in executing the process (Daft and Lengel, 1986). If many roles are involved in a process (high number of participants, high labor intensity), the degree of differentiation increases, as does the

ambiguity (Daft and Lengel, 1986; Haußmann *et al.*, 2010). In addition, if customers are involved in the process (high customer involvement), the goals and experience of people involved in the process are even more differentiated.

Process importance, the final dimension that we propose, has been applied in studies that have adopted an information-processing perspective to the process level (Mani *et al.*, 2006; Premkumar *et al.*, 2005). Process importance refers to the criticality of a process (Premkumar *et al.*, 2005) in terms of how it impacts an organization's competitiveness (Mani *et al.*, 2006). Frequently mentioned process characteristics in this realm were criticality and value contribution. Processes are often classified into core, management, or support processes (Gibb *et al.*, 2006; Duan *et al.*, 2009), with core processes contributing the most directly to a company's success and competitiveness (high importance).

As can be seen from the literature review, there have been many overlaps between the process dimensions identified during the literature review and the categories suggested by OIPT. As a next step, we aimed at reducing overlaps between the process dimensions and further consolidated the process dimensions through an information-processing perspective. To do so, we conducted a sorting exercise in which the process dimensions from the literature review had to be sorted into the five categories from OIPT: interdependence, variability, analyzability, differentiation, and importance. To ensure inter-rater reliability, two of the authors independently categorized the 36 process dimensions. As not all of the dimensions could be mapped easily into one of the five categories, we created a category for dimensions that fit none of the categories and a category for dimensions that fit multiple categories. Our categorization revealed an inter-coder agreement of 83 percent and a Kappa value of 0.78, both of which indicate substantial inter-coder reliability (Landis and Koch, 1977). Then both researchers discussed the dimensions about which they disagreed until consensus was reached. Based on this card sorting exercise, we further consolidated the process dimensions as follows:

(1) Interdependence of process participants: the degree to which process participants unidirectionally or reciprocally exchange resources and information with others in accomplishing their process steps; consolidates the process dimensions of collaboration, interdependence between functional units/tasks, iterativeness, and linearity.

(2) Process variability: the degree to which process inputs/steps/outputs are variable and difficult to predict in advance; consolidates the process dimensions of consistency, customization, flexibility/adaptability, predictability, repeatability, repetitiveness, rigidity, routinization, spontaneity, standardization, structuredness, variety of inputs, and variety of outputs.

(3) Process analyzability: the degree to which personal judgment (as opposed to computational procedures) is required for process execution; consolidates the process dimensions of automation, creativity, formalization, information intensity, knowledge intensity, and personal judgment/thinking.

(4) Differentiation of process participants: the degree to which people whose organizational areas, backgrounds, experience, goals, and priorities differ are involved in executing the process; consolidates the process dimensions of boundaries, customer involvement, number of process participants, and labor intensity.

(5) Process importance: the degree to which a process impacts an organization's competitiveness; consolidates the process dimensions of criticality and value contribution.

We found two process dimensions, uncertainty and complexity, that can be allocated to more than one of the process dimensions suggested by OIPT. If we apply an information-processing perspective, these dimensions would be classified as consequences of process

characteristics, rather than as process characteristics. As an example, interdependence increases uncertainty and, with that, coordination requirements (Daft and Lengel, 1986; Mani *et al.*, 2010). Similarly, if the process variability is high, it is difficult to predict problems and activities in advance, which also increases participants' uncertainty and information-processing requirements. The degree of uncertainty is further increased in situations in which task analyzability is low and experience and personal judgment becomes important for process execution, or in situations in which many different departments are involved within the process leading to a higher differentiation (Haußmann *et al.*, 2010; Daft and Lengel, 1986). Process complexity overlaps with many of the process dimensions derived from the literature and depends heavily on the researcher's or practitioner's understanding of what constitutes a complex process (e.g. many interdependencies, low analyzability, high variability, etc.).

Some process dimensions that we derived from the literature – such as customer type, process time, type of output, and process frequency – could not be consolidated through an information-processing perspective. While the process characteristics we consolidated lead to varying information-processing requirements, the characteristics we could not analyze with this perspective tend to be related to formal process elements that describe whom the process serves, how long it takes, what the output is, and how often the process is performed. While these characteristics are also important to consider in process-management practice, they do not provide information on what is happening during process execution, so they provide no insights into information-processing requirements. We kept these dimensions in a separate group called "formal process elements."

6. Process assessment based on process dimensions – an illustration

Researchers describe differences in processes with a broad variety of process dimensions. Our literature review identified 36 dimensions that have been used to describe organizational processes. Information-processing theory is a useful theoretical lens through which to analyze and consolidate these dimensions and explain why different processes might require different management approaches. In this section, we intend to demonstrate how research and practice can use the consolidated process dimensions to describe differences in processes as a basis for context-sensitive process management. This demonstration uses hypothetical examples of a sales process, a manufacturing process, and a data administration process which are based on our experience in customer projects as well as descriptions of these processes in the literature. These examples are intended to demonstrate how the process dimensions can be evaluated to identify the overall pattern of process characteristics going beyond existing process-classification systems.

6.1 Process importance

The first dimension differentiates processes based on the degree to which a process impacts an organization's competitiveness. According to the process classification of Ould (1995), the sales process and the manufacturing process used in this illustration would both be classified as core processes, as they directly contribute to the organization's value creation (high importance). On the contrary, the data administration process rather has a supporting character (low importance).

6.2 Interdependence of process participants

This dimension describes the degree to which process participants unidirectionally or reciprocally exchange resources and information with others in accomplishing their process steps. Sales processes and manufacturing processes usually have many interdependencies, as people need to work closely with other colleagues or even customers

(Moncrief and Marshall, 2005). Thus, people heavily rely on the work or behavior of other people, which, in our example, is even more difficult for the sales process (high interdependence) as compared to the manufacturing process (medium interdependence) as interactions within a sales process are often not sequential but simultaneous and iterative (Moncrief and Marshall, 2005). The data administration process, on the other hand, can be conducted quite independently with very few people involved (low interdependence).

6.3 Process variability

This dimension describes the degree to which process inputs, steps, or outputs are variable and difficult to predict in advance. While sales processes are usually unpredictable and differ from one time to another (high variability), the manufacturing process is rather stable and predictable (low variability) (Barber and Tietje, 2008). The same logic applies to the data administration process which usually follows a predictable set of steps (low variability).

6.4 Process analyzability

This dimension refers to the degree to which personal judgment (as opposed to computational procedures) is required for process execution. Process participants in our manufacturing and data administration process can follow objective, computational procedures (high analyzability) as compared to the sales process, in which people need to rely mainly on personal judgment and experience (low analyzability). In fact, researchers have argued that in sales processes, relationships, decisions, negotiations and conflict impact process activities and their pace (Barber and Tietje, 2008).

6.5 Differentiation of process participants

The last dimension describes the degree to which people, whose organizational areas, backgrounds, experience, goals, and priorities differ, are involved in executing the process. The background and goals of people involved in the sales process differ more than in the manufacturing process, as also people outside the organization (i.e. the customers) are involved in this process (high differentiation). The manufacturing process also includes multiple, interdependent process participants which might have a different background and experience (medium differentiation). The data administration process in our example involves only a few, rather similar people as mentioned above (low differentiation). An overview of this assessment is shown in Figure 1.

Existing process-classification systems would classify processes in a few, high-level categories such as core, management, and support processes. As such, they only differentiate processes based on one dimension (i.e. process importance) ignoring the

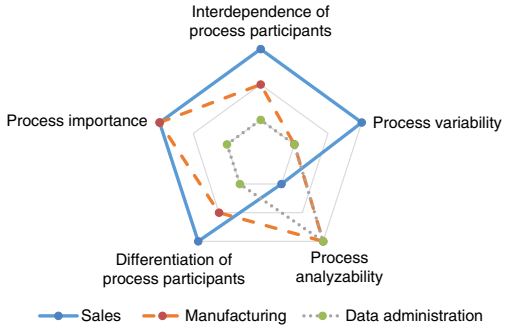

Figure 1.
Illustrative process assessment based on process dimensions

diversity within one category. According to this differentiation, the sales process and the manufacturing process used in this illustration would both be classified as core processes, as they directly contribute to the organization's value creation. Thus, this classification would not necessarily suggest that the two processes should be managed in different ways, while an information-processing perspective, on which our classification is based, would suggest different management approaches, because the processes differ in terms of many other dimensions. This view is supported, for example, by researchers who have argued that sales processes differ largely from manufacturing processes and require the adaptation of management approaches (Barber and Tietje, 2008).

As demonstrated above, our understanding of process differences goes beyond existing frameworks and allows researchers and practitioners to describe processes based on five dimensions. This view suggests that processes can be similar in some dimensions (e.g. the manufacturing and data administration process are both highly analyzable), while still being different in others (e.g. the manufacturing process is highly interdependent and the data administration process is not). Describing organizational processes based on the proposed dimensions suggests a differentiated management approach for different processes. Instead of managing processes with a one-size-fits-all approach, process manager can determine how a process should be managed based on its characteristics.

As an example for process management, OIPT would suggest focusing on coordination and control mechanisms for the sales and manufacturing processes, as they have high levels of interdependence and differentiation in their participants (Galbraith, 1973; Daft and Lengel, 1986). Applying rules and standardized procedures might be more appropriate for processes with higher levels of analyzability and low levels of variability, such as data administration or manufacturing processes, as these processes show lower levels of uncertainty (Galbraith, 1973). This view is supported by process-management research that suggests, for example, that processes with a high degree of uncertainty (e.g. the sales process) are more difficult to standardize than are processes with a lower degree of uncertainty (e.g. the manufacturing and data administration process) (Schaefermeyer *et al.*, 2010, 2012).

Thus, an evaluation of processes based on the five process dimensions can be a starting point from which practitioners can discuss appropriate management approaches and for research to develop context-sensitive process-management practices or to identify processes for which satisfactory process-management practices have not been developed. The evaluation of processes can be done through expert discussions or the development of standardized instruments that help to assess the values on the five process dimensions.

7. Discussion

7.1 Reflecting on our research findings

The purpose of the present research is to conceptualize differences in processes so that appropriate management practices can be derived. Therefore, we systematically determined on which dimensions processes differ, building on prior knowledge and theoretical guidance as suggested by Bailey (1994) and Nickerson *et al.* (2013). We conceptualized process differences based on five dimensions: interdependence, variability, analyzability, differentiation, and importance. While it is well known that processes are different and have to be managed in different ways, it has not systematically been analyzed how processes differ. Thus, we contribute to an understanding of the nature of processes by systematically deriving and consolidating process dimensions from the literature. In addition, we demonstrate that process complexity, the most frequently mentioned process dimension in our literature review, overlaps with many of the other process dimensions. Based on OIPT, we would consider process complexity as a consequence, rather than as a process characteristic itself. As the definition of complexity differs from person to person,

we recommend that researchers and practitioners specify what makes a process complex by describing its underlying process dimensions.

This new way of describing process differences facilitates the improvement of process-management practices. While, to date, process-classification systems remain on a rather abstract level, an understanding of process differences based on process dimensions which are linked to established theories is important to explain why different types of processes require a different management approach. By applying OIPT, we suggest that processes differ in terms of information-processing requirements and management practices should be applied to deal with these requirements. Based on this understanding, management practices can be developed and applied helping to make informed decisions and prevent wasted efforts (Venkatesh, 2006; Schaefermeyer *et al.*, 2010, 2012; Rosenkranz *et al.*, 2010), thereby increasing the efficiency and effectiveness of BPM.

Within the 36 dimensions derived from the literature review, we analyzed 32 using an information-processing perspective, demonstrating that the theory is valuable for clarifying process differences. The remaining four dimensions derived from the literature – such as customer type, process time, type of output, and process frequency – cannot be explained using the theory. The dimensions of OIPT describe how the process is being performed, but these additional characteristics describe what is being done in the process. These dimensions might not ask for other information-processing requirements but could still influence the appropriateness of process-management practices; for example, they could influence the prioritization of BPM practices (e.g. depending on the process volume) or the culture that should be developed in BPM (e.g. depending on the type of customer), so additional mechanisms could be examined to explain context-sensitive process management other than information-processing.

Additional theories that might enhance our findings are other fit theories, for example, task-technology fit (TTF) theory (Goodhue, 1995; Goodhue and Thompson, 1995) or process virtualization theory (Overby, 2008). TTF postulates that a fit between task characteristics and technology characteristics determines performance and utilization of IT (Goodhue, 1995; Goodhue and Thompson, 1995). Process virtualization theory suggests that processes have different requirements (sensory, relationship, synchronism, identification, and control requirements) and that the possibility to virtualize a process depends on these requirements. Both theories examine process differences and could potentially enhance our findings.

7.2 Implications for research

The findings of our study complement research on context-sensitive BPM by introducing factors internal to the process – that is, process dimensions – as critical determinants of BPM. This view extends existing research that often suggest that environmental or organizational contextual factors should be considered in BPM (Trkman, 2010; Rosemann *et al.*, 2008).

We systematically conceptualize process differences by deriving process dimensions from the literature and analyzing the findings using an information-processing perspective. As our illustration shows, researchers involved in process-management research can describe processes based on the process dimensions derived here to define the boundaries of research studies and increase their findings' transparency and comparability which is particularly important for case study research (Yin, 2013). In addition, process characteristics can be included in survey studies as moderator variables to explain conflicting research findings or to develop normative guidelines on how to manage various kinds of processes.

Related to the conceptualization of process differences, we challenge researchers who use process complexity to describe differences in processes. While process complexity was the most frequently mentioned process dimension in the literature, this dimension overlaps

many other dimensions, so it is not helpful in defining processes. As an alternative, we suggest that researchers clearly specify the underlying dimensions of what makes the process complex (e.g. many interdependencies, high variability, low analyzability, high differentiation, and/or high importance). Again, specifying the underlying process dimensions would make research more transparent and comparable.

Finally, our research contributes to information-processing theory, as it constitutes a new field of application for OIPT. We transfer the OIPT (Galbraith, 1973), as a theory of organization design, to the level of organizational processes and demonstrate that it works well in analyzing process dimensions that describe how a process is structured or organized, compared to more formal elements that describe what is being done in the process (e.g. which customers are served, what output is produced). These findings could also inform other research that applies an information-processing perspective to examine additional mechanisms other than information-processing only.

7.3 Implications for practice

By applying an information-processing perspective to the process level, we also contribute to the practice of process-management. Our findings provide an alternative to existing process-classification systems applied in BPM practice and support process managers in deriving appropriate management practices.

First of all, the diversity of process dimensions identified in this study suggests that the classification systems used to characterize processes in BPM practice are not adequate, as they differentiate only between two or three high-level types of processes. Thus, they do not address the diversity of processes within organizations. Categories like "work processes" (Garvin, 1998) and "primary activities" (Porter, 1995) are too broad to help managers understand the nature of a process sufficiently to develop appropriate ways of management. For example, existing frameworks cannot explain why knowledge-intensive processes require a management approach that differs from that of other kinds of processes (Davenport, 2010). Knowledge-intensive and other processes could all be classified as either "primary" or "secondary" activities or as "core," "management," or "support processes," neither of which would suggest a differentiated management approach. Therefore, by focusing on process dimensions, we go beyond existing process-classification schemes that differentiate only among a few high-level types of processes.

Second, an understanding of process differences based on the proposed process dimensions also supports process managers in deriving management recommendations. By using OIPT as a theoretical lens to interpret the findings from our literature review, we suggest that process differences influence information-processing requirements. As a consequence, OIPT proposes that process-management practices (e.g. process modeling, process standardization, process monitoring) should be adapted so that they meet the information-processing requirements of a particular process. As an example, OIPT suggests that processes with a high degree of uncertainty (e.g. the sales process in our illustration or other knowledge-intensive processes) are more difficult to standardize. Instead, process managers should focus on coordination and control mechanisms, such as regular process monitoring, to compensate for the high levels of uncertainty and information-processing requirements. Other processes, on the contrary, have only low levels of information-processing requirements for which a focus on rules and defined procedures (e.g. standardization) is considered sufficient.

Overall, understanding differences in processes based on underlying process dimensions and varying information-processing requirements provides a new perspective to process managers. This view can serve as a basis for strategic decisions on how to manage organizational processes. As there is a variety of different process-management practices (e.g. Lee and Dale, 1998; Kettinger *et al.*, 1997), process manager should examine to what

extent these practices contribute to information-processing capacity and thus, meet the requirements of different processes. Instead of using a one-size-fits-all approach for all processes, managers can analyze differences and derive appropriate management approaches, which should then be subject to future research and empirical evaluations.

8. Limitations and suggestions for future research

Our literature review provides a conceptualization of differences in processes and a possible explanation for why different processes require different management approaches (because of their varying information-processing requirements). While we provide some illustration of how strategic management decisions can be based on an assessment of the processes' characteristics, future research should examine more systematically how BPM practices should be designed to fit the process to be managed. To do so, every process-management initiative (e.g. process modeling, monitoring, standardization, and improvement) could be examined in relation to the nature of the processes and the degree to which they contribute to information-processing capacity. By doing so, resources can be planned and allocated, increasing the effectiveness and efficiency of business processes' management.

BPM methodologies are often designed with a specific application area in mind. Given the origin (Hammer, 2015) and history (Harmon, 2015) of BPM, methods have been developed that consider the requirements of processes in areas like production, logistics, and administration, where the level of processes' formalization, repetition, routinization, and structure (to name just a few characteristics) is comparatively high. Against this background, we call for future research to explicate for which process characteristics these older methods are designed and to develop new methods for the large number of processes for which no methods have been designed.

Based on the process dimensions we have derived, researchers and practitioners can describe differences in processes to increase the transparency and comparability of research findings. However, what is missing are easy-to-use instruments that measure differences in processes. Therefore, another fruitful area for future research regards how to measure process characteristics and how to evaluate them in terms of single dimensions. Future research could work on operationalizing the dimensions and creating instruments researchers and practitioners can use in determining the nature of their processes.

The limitations of our study are related to the data collection and interpretation of our findings. The literature review conducted in this paper is limited to peer-reviewed articles from only two databases, Emerald and ProQuest. Even if we used only two databases to derive relevant literature, we observed overlaps related to the identified articles and process dimensions, which strengthens our findings. Still, we believe that further research should be done here which extends our search to, for example, conference papers, other databases, or larger samples to confirm (or fail to confirm) our findings. Enhancing the literature search is particularly important as some of the process dimensions that we identified in the literature could not be interpreted with OIPT. Therefore, it would be valuable to apply alternative theories to these dimensions.

Our study consolidated process dimensions into higher-level dimensions using information-processing theory. While these dimensions are theoretically independent, so all combinations of process characteristics can exist, whether a typical cluster of processes can be identified that shows the same pattern of process characteristics remains unexamined. Examining relationships between process dimensions and identifying typical cluster of processes is subject to future research which operationalizes and measures process dimensions for a variety of processes.

Finally, the nature of processes is only one lens through which to look at process-management in pursuit of context-sensitivity in BPM research and practice. Our study focuses on specifying process-related factors (i.e. process dimensions) as critical

determinants of BPM initiatives' success. However, future research should consider additional contextual factors (e.g. vom Brocke *et al.*, 2016) and integrate them with our findings to obtain a more holistic view of context-sensitive BPM.

9. Conclusion

The purpose of this paper is to explicate the dimensions that underlie processes. While it is well known that processes are different and have to be managed in different ways, it has not systematically been analyzed how processes differ. We conducted a systematic literature review and applied organizational information-processing theory to the process level to show how the theory can be used to identify differences in processes. Our understanding of process differences goes beyond existing process-classification systems used in process-management research and practice. Often, processes classification systems remain rather abstract and cannot explain why processes have different management requirements. Identifying underlying dimensions and linking them to theories is an important step in understanding process differences and management requirements. The results described and discussed in this paper provide an important basis for future research that can analyze or develop appropriate management practices for specific types of processes. This would enable the development of context-sensitive BPM approaches that helps to increase the acceptance of BPM. At the same time, context-sensitivity can help to avoid wasted efforts and can increases the efficiency and effectiveness of BPM.

References

Ahire, S.L. and Dreyfus, P. (2000), "The impact of design management and process management on quality: an empirical investigation", *Journal of Operations Management*, Vol. 18 No. 5, pp. 549-575.

Al-Sudairi, A.A. (2007), "Evaluating the effect of construction process characteristics to the applicability of lean principles", *Construction Innovation: Information, Process, Management*, Vol. 7 No. 1, pp. 99-121.

Bailey, K.D. (1994), *Typologies and Taxonomies – An Introduction to Classification Techniques*, Sage Publications, Thousand Oaks, CA.

Bala, H. (2013), "The effects of IT-enabled supply chain process change on job and process outcomes: a longitudinal investigation", *Journal of Operations Management*, Vol. 31 No. 6, pp. 450-473.

Bala, H. and Venkatesh, V. (2013), "Changes in employees' job characteristics during an enterprise system implementation: a latent growth modeling perspective", *MIS Quarterly*, Vol. 37 No. 4, pp. 1113-1140.

Barber, C.S. and Tietje, B.C. (2008), "A research agenda for value stream mapping the sales process", *Journal of Personal Selling & Sales Management*, Vol. 28 No. 2, pp. 155-165.

BearingPoint (2015), "Business process management study 2015", available at: www.bearingpoint.com/de-de/7-11740/business-process-management-studie-2015/ (accessed July 15, 2015).

Benner, M.J. and Tushman, M.L. (2003), "Exploitation, exploration, and process management: the productivity dilemma revisited", *Academy of Management Review*, Vol. 28 No. 2, pp. 238-256.

Brownell, P. and Merchant, K.A. (1990), "The budgetary and performance influences of product standardization and manufacturing process automation", *Journal of Accounting Research*, Vol. 28 No. 2, pp. 388-397.

Burgess, K., Singh, P.J. and Koroglu, R. (2006), "Supply chain management: a structured literature review and implications for future research", *International Journal of Operations & Production Management*, Vol. 26 No. 7, pp. 703-729.

Cho, S.E. (2006), "Characteristics of service processes and their implications in electronic commerce: a classification of intangible products", *International journal of electronic business*, Vol. 4 No. 1, pp. 83-98.

Chou, M.C., Chua, G.A. and Teo, C.P. (2010), "On range and response: dimensions of process flexibility", *European Journal of Operational Research*, Vol. 207 No. 2, pp. 711-724.

Clegg, B. and Wan, Y. (2013), "Managing enterprises and ERP systems: a contingency model for the enterprization of operations", *International Journal of Operations & Production Management*, Vol. 33 Nos 11/12, pp. 1458-1489.

Daft, R.L. and Lengel, R.H. (1986), "Organizational information requirements, media richness and structural design", *Management Science*, Vol. 32 No. 5, pp. 554-571.

Daft, R.L. and Macintosh, N.B. (1981), "A tentative exploration into the amount and equivocality of information processing in organizational work units", *Administrative science quarterly*, Vol. 26 No. 2, pp. 207-224.

Danese, P. and Romano, P. (2011), "Supply chain integration and efficiency performance: a study on the interactions between customer and supplier integration", *Supply Chain Management: An International Journal*, Vol. 16 No. 4, pp. 220-230.

Davenport, T.H. (2010), "Process management for knowledge work", in vom Brocke, J. and Rosemann, M. (Eds), *Handbook on Business Process Management 1: Introduction, Methods and Information Systems*, Springer, Berlin, pp. 17-35.

De Bruin, T. and Rosemann, M. (2004), "Application of a holistic model for determining BPM maturity", in Akoka, J., Comyn-Wattiau, I. and Favier, M. (Eds), *Proceedings of the 3rd Pre-ICIS Workshop on Process Management and Information Systems*, Washington, DC, pp. 46-60.

De Jong, J.P. and Vermeulen, P.A. (2003), "Organizing successful new service development: a literature review", *Management Decision*, Vol. 41 No. 9, pp. 844-858.

Donaldson, L. (2001), *The Contingency Theory of Organizations*, Sage Publications, Thousand Oaks, CA.

Duan, C., Grover, V. and Balakrishnan, N.R. (2009), "Business process outsourcing: an event study on the nature of processes and firm valuation", *European Journal of Information Systems*, Vol. 18 No. 5, pp. 442-457.

Eppler, M.J., Seifried, P. and Röpnack, A. (1999), "Improving knowledge intensive processes through an enterprise knowledge medium", *Proceedings of the 1999 ACM SIGCPR Conference on Computer Personnel Research, ACM, New York, NY*, pp. 222-230.

Fang, E. (2011), "The effect of strategic alliance knowledge complementarity on new product innovativeness in China", *Organization Science*, Vol. 22 No. 1, pp. 158-172.

Feitzinger, E. and Lee, H.L. (1997), "Mass customization at hewlett-packard: the power of postponement", *Harvard Business Review*, Vol. 75 No. 1, pp. 116-121.

Field, J.M., Ritzman, L.P., Safizadeh, M.H. and Downing, C.E. (2006), "Uncertainty reduction approaches, uncertainty coping approaches, and process performance in financial services", *Decision Sciences*, Vol. 37 No. 2, pp. 149-175.

French, M.L. and LaForge, R.L. (2006), "Closed-loop supply chains in process industries: an empirical study of producer re-use issues", *Journal of Operations Management*, Vol. 24 No. 3, pp. 271-286.

Galbraith, J.R. (1973), *Designing Complex Organizations*, Addison-Wesley, Reading, MA.

Garvin, D.A. (1998), "The processes of organization and management", *Sloan Management Review*, Vol. 39 No. 4, pp. 33-51.

Gassmann, O. (2006), "Opening up the innovation process: towards an agenda", *R&D Management*, Vol. 36 No. 3, pp. 223-228.

Gebauer, J. and Lee, F. (2008), "Enterprise system flexibility and implementation strategies: aligning theory with evidence from a case study", *Information Systems Management*, Vol. 25 No. 1, pp. 71-82.

Gibb, F., Buchanan, S. and Shah, S. (2006), "An integrated approach to process and service management", *International Journal of Information Management*, Vol. 26 No. 1, pp. 44-58.

Goodhue, D.L. (1995), "Understanding user evaluations of information systems", *Management Science*, Vol. 41 No. 12, pp. 1827-1844.

Goodhue, D.L. and Thompson, R.L. (1995), "Task-technology fit and individual performance", *MIS Quarterly*, Vol. 19 No. 2, pp. 213-236.

Goodhue, D.L., Wybo, M.D. and Kirsch, L.J. (1992), "The impact of data integration on the costs and benefits of information systems", *MIS Quarterly*, Vol. 16 No. 3, pp. 293-311.

Griffin, A. (1997), "The effect of project and process characteristics on product development cycle time", *Journal of Marketing Research*, Vol. 34 No. 1, pp. 24-35.

Groenroos, C. (1998), "Marketing services: the case of a missing product", *Journal of Business & Industrial Marketing*, Vol. 13 Nos 4/5, pp. 322-338.

Hagras, H., Callaghan, V. and Colley, M. (1999), "An embedded-agent technique for industrial control environments where process modelling is difficult", *Assembly Automation*, Vol. 19 No. 4, pp. 323-331.

Hall, J.M. and Johnson, M.E. (2009), "When should a process be art, not science?", *Harvard Business Review*, Vol. 87 No. 3, pp. 58-65.

Hammer, M. (2015), "What is business process management?", in vom Brocke, J. and Rosemann, M. (Eds), *Handbook on Business Process Management 1: Introduction, Methods and Information Systems*, Springer, Berlin, pp. 3-16.

Hanna, M.D., Newman, W.R. and Johnson, P. (2000), "Linking operational and environmental improvement through employee involvement", *International Journal of Operations & Production Management*, Vol. 20 No. 2, pp. 148-165.

Harmon, P. (2007), *Business Process Change: A Guide for Business Managers and BPM and Six Sigma Professionals*, Morgan Kaufmann, Burlington, MA.

Harmon, P. (2015), "The scope and evolution of business process management", in vom Brocke, J. and Rosemann, M. (Eds), *Handbook on Business Process Management 1: Introduction, Methods and Information Systems*, Springer, Berlin, pp. 37-80.

Harrison, A. (1998), "Investigating business processes: does process simplification always work?", *Business Process Management Journal*, Vol. 4 No. 2, pp. 137-153.

Haußmann, C., Dwivedi, Y.K., Venkitachalam, K. and Williams, M.D. (2010), "A summary and review of Galbraith's organizational information processing theory", in Dwivedi, Y.K., Wade, M.R. and Schneberger, S.L. (Eds), *Information Systems Theory*, Springer, Heidelberg, pp. 71-92.

Helkiö, P. and Tenhiälä, A. (2013), "A contingency theoretical perspective to the product-process matrix", *International Journal of Operations & Production Management*, Vol. 33 No. 2, pp. 216-244.

Hofstede, G. (1978), "The poverty of management control philosophy", *Academy of Management Review*, Vol. 3 No. 3, pp. 450-461.

Huang, M.C., Yen, G.F. and Liu, T.C. (2014), "Reexamining supply chain integration and the supplier's performance relationships under uncertainty", *Supply Chain Management: An International Journal*, Vol. 19 No. 1, pp. 64-78.

Isik, Ö., Mertens, W. and Van den Bergh, J. (2013), "Practices of knowledge intensive process management: quantitative insights", *Business Process Management Journal*, Vol. 19 No. 3, pp. 515-534.

Johansson, P. and Olhager, J. (2006), "Linking product-process matrices for manufacturing and industrial service operations", *International Journal of Production Economics*, Vol. 104 No. 2, pp. 615-624.

Kallio, J., Saarinen, T., Tinnilä, M. and Vepsäläinen, A.P. (2000), "Measuring delivery process performance", *International Journal of Logistics Management*, Vol. 11 No. 1, pp. 75-88.

Kellogg, D.L. and Nie, W. (1995), "A framework for strategic service management", *Journal of Operations Management*, Vol. 13 No. 4, pp. 323-337.

Kettinger, W., Teng, J. and Guha, S. (1997), "Business process change: a study of methodologies, techniques, and tools", *MIS Quarterly*, Vol. 21 No. 1, pp. 55-80.

Kohlbacher, M. (2010), "The effects of process orientation: a literature review", *Business Process Management Journal*, Vol. 16 No. 1, pp. 135-152.

Komashie, A., Mousavi, A. and Gore, J. (2007), "Quality management in healthcare and industry: a comparative review and emerging themes", *Journal of Management History*, Vol. 13 No. 4, pp. 359-370.

Kulkarni, U. and Ipe, M. (2007), "Decision support for knowledge intensive business processes", *Proceedings of the ADPSI Conference*.

Landis, J.R. and Koch, G.G. (1977), "The measurement of observer agreement for categorical data", *Biometrics*, Vol. 33 No. 1, pp. 159-174.

Lau, R.S.M., Zhao, X. and Lai, F. (2002), "Survey of MRP II implementation and benefits in mainland China and Hong Kong", *Production and Inventory Management Journal*, Vol. 43 Nos 3/4, pp. 65-71.

Lee, R.G. and Dale, B.G. (1998), "Business process management: a review and evaluation", *Business Process Management Journal*, Vol. 4 No. 3, pp. 214-225.

Lillrank, P. (2003), "The quality of standard, routine and non-routine processes", *Organization Studies*, Vol. 24 No. 2, pp. 215-233.

Ma, C., Yang, Z., Yao, Z., Fisher, G. and Fang, E.E. (2012), "The effect of strategic alliance resource accumulation and process characteristics on new product success: exploration of international high-tech strategic alliances in China", *Industrial Marketing Management*, Vol. 41 No. 3, pp. 469-480.

Mackelprang, A.W., Jayaram, J. and Xu, K. (2012), "The influence of types of training on service system performance in mass service and service shop operations", *International Journal of Production Economics*, Vol. 138 No. 1, pp. 183-194.

Mani, D., Barua, A. and Whinston, A. (2006), "Successfully governing business process outsourcing relationships", *MIS Quarterly Executive*, Vol. 5 No. 1, pp. 15-29.

Mani, D., Barua, A. and Whinston, A.B. (2010), "An empirical analysis of the impact of information capabilities design on business process outsourcing performance", *Management Information Systems Quarterly*, Vol. 43 No. 1, pp. 39-62.

Marjanovic, O. and Freeze, R. (2011), "Knowledge intensive business processes: theoretical foundations and research challenges", *Proceedings of the 44th Hawaii International Conference on System Sciences in Kauai, IEEE Computer Society, Hawaii*, pp. 1-10.

Marjanovic, O. and Seethamraju, R. (2008), "Understanding knowledge-intensive, practice-oriented business processes", *Proceedings of the 41st Hawaii International Conference on System Sciences in Waikoloa, Hawaii, IEEE Computer Society*, pp. 373-383.

Melão, N. and Pidd, M. (2000), "A conceptual framework for understanding business processes and business process modelling", *Information Systems Journal*, Vol. 10 No. 2, pp. 105-129.

Mohr, L.B. (1971), "Organizational technology and organizational structure", *Administrative Science Quarterly*, Vol. 16 No. 4, pp. 444-459.

Moncrief, W.C. and Marshall, G.W. (2005), "The evolution of the seven steps of selling", *Industrial Marketing Management*, Vol. 34 No. 1, pp. 13-22.

Morgan, G. (2007), *Images of Organization*, Sage, Thousand Oaks, CA.

Nadia, B., Gregory, G. and Vince, T. (2006), "Engineering change request management in a new product development process", *European Journal of Innovation Management*, Vol. 9 No. 1, pp. 5-19.

Nickerson, R.C., Varshney, U. and Muntermann, J. (2013), "A method for taxonomy development and its application in information systems", *European Journal of Information Systems*, Vol. 22 No. 3, pp. 336-359.

Ould, M.A. (1995), *Business Processes: Modelling and Analysis for Re-engineering and Improvement*, Wiley, Chichester.

Overby, E.M. (2008), "Process virtualization theory and the impact of information technology", *Organization Science*, Vol. 19 No. 2, pp. 277-291.

Papavassiliou, G. and Mentzas, G. (2003), "Knowledge modelling in weakly-structured business processes", *Journal of Knowledge Management*, Vol. 7 No. 2, pp. 18-33.

Papavassiliou, G., Ntioudis, S., Abecker, A. and Mentzas, G. (2003), "Supporting knowledge-intensive work in public administration processes", *Knowledge and Process Management*, Vol. 10 No. 3, pp. 164-174.

Porter, M.E. (1995), *Competitive Advantage*, The Free Press, New York, NY.

Premkumar, G., Ramamurthy, K. and Saunders, C.S. (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.

Puiu, C., Stanciu, M. and Sîrbu, M. (2009), "Understanding the strategic planning process", *Revista Academiei Fortelor Terestre*, Vol. 14 No. 1, pp. 68-73.

Rajaram, K. and Corbett, C.J. (2002), "Achieving environmental and productivity improvements through model-based process redesign", *Operations Research*, Vol. 50 No. 5, pp. 751-763.

Richter-von Hagen, C., Ratz, D. and Povalej, R. (2005), "Towards self-organizing knowledge intensive processes", *Journal of Universal Knowledge Management*, No. 2, pp. 148-169.

Rodríguez-Díaz, M. and Espino-Rodríguez, T.F. (2006), "Developing relational capabilities in hotels", *International Journal of Contemporary Hospitality Management*, Vol. 18 No. 1, pp. 25-40.

Roe, E.M. (1988), "Counting on comparative budgeting in Africa", *International Journal of Public Administration*, Vol. 11 No. 3, pp. 341-356.

Rosemann, M., Recker, J. and Flender, C. (2008), "Contextualization of business processes", *International Journal of Business Process Integration and Management*, Vol. 3 No. 1, pp. 47-60.

Rosen, L.D. and Karwan, K.R. (1994), "Prioritizing the dimensions of service quality: an empirical investigation and strategic assessment", *International Journal of Service Industry Management*, Vol. 5 No. 4, pp. 39-52.

Rosenkranz, C., Seidel, S., Mendling, J., Schaefermeyer, M. and Recker, J. (2010), "Towards a framework for business process standardization", in Rinderle-Ma, S., Sadiq, S. and Leymann, F. (Eds), *Business Process Management Workshops, BPM 2009, Lecture Notes in Business Information Processing*, Springer, Berlin, pp. 53-63.

Safizadeh, M.H., Field, J.M. and Ritzman, L.P. (1999), "An empirical analysis of financial services processes with a front-office or back-office orientation", *Journal of Operations Management*, Vol. 21 No. 5, pp. 557-576.

Sarnikar, S. and Deokar, A. (2010), "Knowledge management systems for knowledge-intensive processes: design approach and an illustrative example", *Proceedings of the 43rd Hawaii International Conference on System Sciences in Kauai, Hawaii, IEEE Computer Society*, pp. 1-21.

Schaefermeyer, M., Grgecic, D. and Rosenkranz, C. (2010), "Factors influencing business process standardization – a multiple case study", *Proceedings of the 43rd Hawaii International Conference on System Sciences, IEEE, 2007, Honolulu, HI*, pp. 1-10.

Schaefermeyer, M., Rosenkranz, C. and Holten, R. (2012), "The impact of business process complexity on business process standardization – an empirical study", *Business & Information Systems Engineering*, Vol. 4 No. 5, pp. 261-270.

Schmahl, K.E. (1996), "Variation in success of implementation of a decision support/finite scheduling system", *Production and Inventory Management Journal*, Vol. 37 No. 1, pp. 28-35.

Segars, A.H. and Grover, V. (1998), "Strategic information systems planning success: an investigation of the construct and its measurement", *MIS Quarterly*, Vol. 22 No. 2, pp. 139-163.

Seidel, S., Shortland, K., Court, D. and Elzinga, D. (2015), "Managing creativity-intensive processes: learning from film and visual effects production", in vom Brocke, J. and Rosemann, M. (Eds), *Handbook on Business Process Management 2: Strategic Alignment, Governance, People and Culture*, Springer, Berlin, pp. 715-740.

Setia, P., Venkatesh, V. and Joglekar, S. (2013), "Leveraging digital technologies: how information quality leads to localized capabilities and customer service performance", *MIS Quarterly*, Vol. 37 No. 2, pp. 565-590.

Silvestro, R., Fitzgerald, L., Johnston, R. and Voss, C. (1992), "Towards a classification of service processes", *International Journal of Service Industry Management*, Vol. 3 No. 3, pp. 62-75.

Slaughter, S.A., Levine, L., Ramesh, B., Pries-Heje, J. and Baskerville, R. (2006), "Aligning software processes with strategy", *MIS Quarterly*, Vol. 30 No. 4, pp. 891-918.

Sousa, K., Mendonça, H., Lievyns, A. and Vanderdonckt, J. (2011), "Getting users involved in aligning their needs with business processes models and systems", *Business Process Management Journal*, Vol. 17 No. 5, pp. 748-786.

Sprigg, C.A., Jackson, P.R. and Parker, S.K. (2000), "Production teamworking: the importance of interdependence and autonomy for employee strain and satisfaction", *Human Relations*, Vol. 53 No. 11, pp. 1519-1543.

Stremtan, F., Mihalache, S.Ş. and Pioraş, V. (2009), "On the internationalization of the firms – from theory to practice", *Annales Universitatis Apulensis Series Oeconomica*, Vol. 11 No. 2, pp. 1025-1033.

Subramaniam, C. and Shaw, M.J. (2004), "The effects of process characteristics on the value of B2B e-procurement", *Information Technology and Management*, Vol. 5 No. 1, pp. 161-180.

Swenson, K.D. and Palmer, N. (2010), *Mastering the Unpredictable: How Adaptive Case Management Will Revolutionize the Way that Knowledge Workers Get Things Done*, Meghan-Kiffer Press, Tampa, FL.

Tachizawa, E. and Yew Wong, C. (2014), "Towards a theory of multi-tier sustainable supply chains: a systematic literature review", *Supply Chain Management: An International Journal*, Vol. 19 Nos 5/6, pp. 643-663.

Teng, J.T., Grover, V. and Fiedler, K.D. (1994), "Business process reengineering: charting a strategic path for the information age", *California Management Review*, Vol. 36 No. 3, pp. 9-31.

Tenhiälä, A. (2011), "Contingency theory of capacity planning: the link between process types and planning methods", *Journal of Operations Management*, Vol. 29 No. 1, pp. 65-77.

Terrion, J.L. and Leonard, D. (2007), "A taxonomy of the characteristics of student peer mentors in higher education: findings from a literature review", *Mentoring & Tutoring*, Vol. 5 No. 2, pp. 149-164.

Thompson, J. (1967), *Organizations in Action*, McGraw-Hill, New York, NY.

Trkman, P. (2010), "The critical success factors of business process management", *International Journal of Information Management*, Vol. 30 No. 2, pp. 125-134.

Tushman, M.L. and Nadler, D.A. (1978), "Information processing as an integrating concept in organizational design", *Academy of Management Review*, Vol. 3 No. 3, pp. 613-624.

Van de Ven, A.H. and Delbecq, A.L. (1974), "A task contingent model of work-unit structure", *Administrative Science Quarterly*, Vol. 19 No. 2, pp. 183-197.

Vanhaverbeke, W. and Torremans, H. (1999), "Organizational structure in process-based organizations", *Knowledge and Process Management*, Vol. 6 No. 1, pp. 41-52.

Varela, J. and Benito, L. (2005), "New product development process in Spanish firms: typology, antecedents and technical/marketing activities", *Technovation*, Vol. 25 No. 4, pp. 395-405.

Vargas, G.A. and Johnson, T.W. (1992), "An analysis of factors in selecting a 'Maquiladora' operational mode", *Production and Inventory Management Journal*, Vol. 33 No. 4, pp. 46-53.

Venkatesh, V. (2006), "Where to go from here? Thoughts on future directions for research on individual-level technology adoption with a focus on decision making", *Decision Science*, Vol. 37 No. 4, pp. 497-518.

Victorino, L., Verma, R. and Wardell, D.G. (2013), "Script usage in standardized and customized service encounters: implications for perceived service quality", *Production and Operations Management*, Vol. 22 No. 3, pp. 518-534.

Vilkas, M. and Stancikas, E.R. (2005), "Typology of organization's processes", *Engineering Economics*, Vol. 43 No. 3, pp. 35-41.

vom Brocke, J. and Sinnl, T. (2011), "Culture in business process management: a literature review", *Business Process Management Journal*, Vol. 17 No. 2, pp. 357-377.

vom Brocke, J., Simons, A., Niehaves, B., Riemer, K., Plattfaut, R. and Cleven, A. (2009), "Reconstructing the giant: on the importance of rigour in documenting the literature search process", *Proceedings of the 17th European Conference on Information Systems in Verona*, pp. 2206-2217.

vom Brocke, J., Zelt, S. and Schmiedel, T. (2016), "On the role of context in business process management", *International Journal of Information Management*, Vol. 36 No. 3, pp. 486-495.

Webster, J. and Watson, R.T. (2002), "Analyzing the past to prepare for the future: writing a literature review", *Management Information Systems Quarterly*, Vol. 26 No. 2, pp. 13-23.

Whitey, M., Daft, R.L. and Cooper, W.H. (1983), "Measures of Perrow's work unit technology: an empirical assessment and a new scale", *Academy of Management Journal*, Vol. 26 No. 1, pp. 45-63.

Yin, R.K. (2013), *Case Study Research: Design and Methods*, Sage Publications, Thousand Oaks, CA.

Zeithaml, V.A., "Rajan" Varadarajan, P. and Zeithaml, C.P. (1988), "The contingency approach: its foundations and relevance to theory building and research in marketing", *European Journal of Marketing*, Vol. 22 No. 7, pp. 37-64.

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