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Managing next generation BP-x initiatives

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Abstract

Past generations of BPM involved the efficient and effective management of business processes. Yet, we currently face a turning point. The technological facets of data-driven BPM add complexity to traditional BPM applications. As a result, organizations face intended and unintended technology-related changes across all business process initiatives. Using the term BP-x, we summarize the recent changes in BPM knowledge that has hitherto been fragmented across academic literature. To address the challenges of BP-x initiatives, we envision a holistic model that focuses on managing related cutting-edge technologies and BPM. Thus, we propose the operationalized BP-x management model as a valuable IT meta-artifact. We develop the model using a two-cycled Design Science Research methodology and conduct a threefold summative evaluation. The results of our study indicate that creating awareness of potentials and opportunities accelerates the process toward action and fosters new business outcomes in terms of performance and innovation. By strategically aligning BP-x endeavors, organizations promote visibility, shared understanding, and culture among stakeholders. Our model guides managers throughout the BP-x adoption journey in conjunction with organizational, managerial, and technological prerequisites.

Keywords BPM · Process analytics · Predictive analytics · Prescriptive analytics · Process automation

1 Introduction

Business Process Management (BPM) manages organizational operations to foster effective and efficient processes (Dumas et al. 2018). As technology continues to evolve, its usage to support BPM is no longer limited to one or a few applications

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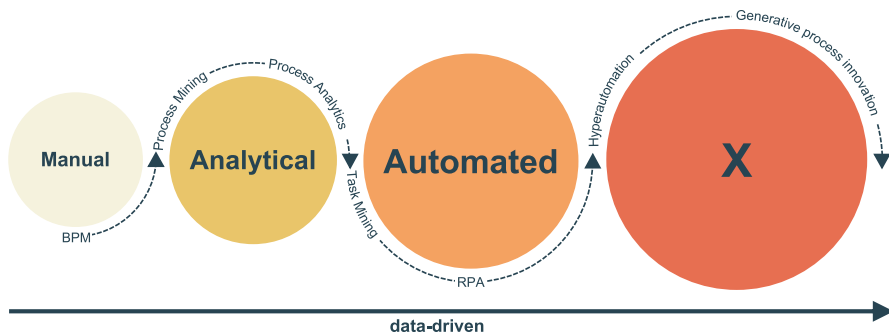


Fig. 1 A data-driven view of BP-x with exemplary technologies

but extends to an organizational phenomenon. Current BPM technologies include process mining (PM), artificial intelligence (AI), or robotic process automation (RPA), which are being deployed to enhance and improve employees' work through data and insights. Although BPM has been rapidly implemented in practice and its transformative potential has been recognized, organizations have uncertainties about how to manage its technical aspects and impacts (vom Brocke et al. 2020b).

The rapid transition from manual process modeling and redesign to automated and data-driven process management exacerbates uncertainties (Beerepoot et al. 2023). As a response to these changing conditions, the multidisciplinary fusion of BPM and novel technologies has led to a plethora of approaches in the realm of BPM (e.g., Oberdorf et al. (2022); Mehdiyev and Fettke (2020); Axmann et al. (2021)). However, the conceptual understanding is fragmented, and no nomenclature captures the existing and upcoming trends that will shape the future of BPM. Thus, we define the novel term BP-x as a term for the advancements of the BPM domain in light of data-, technology-, and human-centric changes. Figure 1 illustrates the chronological development of BP-x, with the circle size indicating that business value creation is gaining momentum with more data- and technology-driven approaches.

According to some reports, more than half of all organizations plan to invest in these new generation BPM technologies (Kerremans et al. 2021; Lavelle 2022), and the applications are expanding at a startling rate. Given the current pace of technology investment, today's managers need guidance to unfold the power of jointly optimizing social and technical aspects in ways that preserve and generate value (Badakhshan et al. 2022). As the "technical implementation, individual adoption, and actual use" (vom Brocke et al. 2021b, p.487) of technologies is a prerequisite for positive outcomes on an organizational level, it falls on the shoulders of managers to communicate, lead, and control organizational activities to achieve corporate goals (Porter 1985). Thus, managers are in charge of allocating resources, overseeing BP-x initiatives, and governing organizations.

Information systems (IS) scholars have recognized the management of innovative technologies as a crucial component in generating profitable organizational results (Mata et al. 1995; Mithas et al. 2011; Nambisan et al. 2017). Over the years, an

enormous amount of research has been devoted to BPM's managerial and organizational facets. Despite this knowledge foundation, recent advancements with cutting-edge technology linked to data-driven BPM primarily concentrate on technical factors (Grisold et al. 2020a). The innovation and complexity added by new research on BP-x go beyond what is seen in conventional BPM applications. Therefore, organizations must develop unique capabilities exceeding traditional BPM (Beverungen et al. 2021; Kerpedzhiev et al. 2021). To date, little attention has been given to how organizations can leverage the prospects revealed by obtaining unique BP-x capabilities. In practice, it could be helpful to structure the road map for BP-x initiatives by incorporating novel capabilities while remaining aware of the BPM foundation. This backdrop served as the motivation to investigate the following research question:

RQ: *How can organizations realize the full potential of BP-x?*

To address this question, we apply a two-cycled Design Science Research (DSR) methodology following (Peffer et al. 2007) and propose an IT meta-artifact to guide future BP-x uptake. In doing so, we aim to systematize the steps that organizations need to take to create value with BP-x initiatives. Thus, we provide guidance to help managers and process practitioners envision future potentials and opportunities. Our proposed *operationalized BP-x management* model helps to build awareness and creates a common understanding in organizations to accelerate the process toward action. This study elucidates how we need to adapt and reinvent the knowledge of BPM to efficiently address the opportunities and challenges presented by novel technology for digital process management.

The remainder of this article is organized into ten distinct sections. Section 2 presents the fundamental ideas underlying BPM in light of contemporary trends; then, Sects. 3 and 4 position our proposal within existing research and theories. Section 5 provides an overview of our research design. Then, Sect. 6 outlines some of the critical outcomes of our model design and development phase. Section 7 presents the final model for operationalizing BP-x initiatives in organizations. Subsequently, Sect. 8 examines the evaluation strategy of our final artifact. Next, we discuss our findings in Sect. 9 and highlight theoretical and practical implications. Finally, in Sect. 10, we conclude the article with an outlook on future research avenues.

2 Conceptualization

In the following sub-sections, we conceptualize the meaning of BPM by specifying what it is and how current trends affect the development of the research field.

2.1 Business process management

The concept of BPM emanates from management techniques aimed at process orientation through the alignment of business processes with an organization's objectives and customer needs (Lee and Dale 1998). As BPM was taking root, the seminal publications by Davenport (1993) and Hammer and Champy (1993) significantly advanced the evolution of BPM to a process science (Rescher 1996) discipline that

emerged from management research. Since then, the goal of BPM has evolved from an efficiency and cost-based perspective to “overseeing how work is performed in an organization to ensure consistent outcomes and to take advantage of improvement opportunities” (Dumas et al. 2018, p. 1).

From a meta-perspective, research on BPM investigates how organizations can operate this management efficiently (Reijers 2021), how they can model, (re-)design, and orchestrate processes (Dumas et al. 2018), and how they develop the foundational capabilities required (vom Brocke and Rosemann 2015). For example, the well-established capability framework by de Bruin and Rosemann (2007) classifies capability areas according to six core elements of BPM—strategic alignment, governance, methods, information technology (IT), people, and culture—to identify the skills that contribute to achieving the desired objectives (e.g., van Looy et al. (van Looy et al. 2017)). These capabilities can change or expand through new socio-technical challenges (Kerpedzhiev et al. 2021) stimulated by the digitalization of organizations and the continuous expansion of methods, techniques, and tools for BPM (Reijers 2021; Beverungen et al. 2021).

Historically, management techniques were accompanied by Business Process Management Systems (BPMS), which constituted a core technology of the BPM discipline. This opened up new avenues for analysis, such as tracking business processes (Grigori et al. 2004). To date, BPM is still closely connected to the management science discipline. However, due to the recent rise of novel technological advancements, it “sits at the intersection of computer science, information systems engineering, management science, and industrial engineering” (Reijers 2021, p. 4).

On a higher level, BPM is categorized in the field of process science, which seeks to study processes scientifically with an interdisciplinary perspective on continuous change (vom Brocke et al. 2021a). The process science discipline evolved from the growing demand for more scientific and empirical research in the context of BPM (Mendling 2016) and encompasses a holistic perspective on processes that goes beyond business processes and related knowledge (vom Brocke et al. 2021a).

To summarize the current concepts and trends in the BPM literature, we follow Lederer et al. (2020) and categorize them into the triad of contemporary BPM: (1) data, (2) technology, and (3) human.

2.1.1 Technology

The use of technologies in BPM is a growing trend that has the potential to improve business processes and decision-making significantly. Thus, it will become increasingly important for organizations to integrate technological enablers into their BPM strategies. Recent technological enablers that greatly influence the BPM paradigm include blockchain technology (Mendling et al. 2018), the Internet of things (Jani-esch et al. 2017), AI (Takeuchi and Yamamoto 2020), cognitive computing (Roeglinger et al. 2018), social computing, smart devices, big data analytics, and real-time computing (Beverungen et al. 2021). This list of technological enablers is not exhaustive, but it demonstrates the variety and diversity of technologies that challenge process participants’ roles and main tasks.

2.1.2 Data

Various technologies foster digitization and digitalization (Baiyere et al. 2023) and enable the low-cost access and storage of vast amounts of data (Brynjolfsson and McAfee 2014). The main challenge of dealing with collected data is conducting targeted analyses to understand the data and add value to the related organization. Consequently, an amalgamation of several sub-disciplines has emerged as the field of data science (van Eck et al. 2015). Data science connects to business analysis and processes via targeted analysis of process execution data (i.e., event logs). Relatedly, novel BPM sub-disciplines connected to the Business Intelligence and Analysis (BI&A) realm have arisen (Badakhshan et al. 2022). For instance, the subordinate stream of research on Business Process Intelligence (BPI) recognizes a distinct subclass of BI tools that extends them to include business process characteristics (Grigori et al. 2004; van der Aalst et al. 2015). This includes applying BI techniques to analyze, predict, monitor, control, and optimize business processes (Grigori et al. 2004). Since the emergence of BPI, BPM and BI have been intertwined. Nevertheless, observations in practice and research show that the link between data supporting BPM strategies is still fragmented (Suša Vugec et al. 2020; Beerepoot et al. 2023).

2.1.3 Human

Although data and technological enablers are strong drivers of organizational productivity, the linchpin of any organization is the humans involved. Finally, BPM is the nexus among processes, technology, and human, as it blends the management of processes with technological support to foster the control and optimization of human work. Current research covers user-centricity, trust, or transparency issues and focuses on capability enhancement concerning employee alignment and process performance (Lederer et al. 2020). Despite this contemporary trend, the human factor is a basic theme and an inherent part of BPM that emerged from the management discipline. For example, humanness sets the foundation for organizational context-awareness that significantly influences the success of BPM initiatives (see, e.g., Shah and Wilson 1989; van Looy et al. 2017; Van Looy and De Backer 2013).

2.2 A futuristic view of business process management

With this in mind, where do the recent advances in the sub-streams of BPM fit? The short recap on the history and concepts of BPM demonstrate the need to forge a new nomenclature around the current change, the novel technology, and its use in practice. We posit a profound and fundamental context shift around BPM given the recent progress of IT capabilities, which has been accelerated by the processes of digitization and digitalization and growing awareness of human aspects for successful BPM initiatives.

We next synthesize the pivotal characteristics in this new epoch that justify using a new nomenclature. In doing so, we draw on the guidelines provided by Baiyere et al. (2023) and ground our justification on prior literature to motivate the change in nomenclature and condense them into three ongoing shifts, which we identify as foundational.

Data: Nearly all states and events of the world are digitized and stored as traceable digital objects (i.e., data). The process of digitization and downstream digitalization catalyzes new technologies and advancements in the BPM discipline (Beverungen et al. 2021). Organizations can access and derive value from vast amount of various kinds of data (Beerepoot et al. 2023).

Technology: Digitalization has opened up new possibilities for organizations using and leveraging data. Since the introduction of digitalization, the focus has been on developing new ways and opportunities that add value. At the same time, the cost of processing data has decreased, enabling new means of processing data to support human decision-making.

Human: Changing working conditions, worldwide competition, workforce skills development, and creating and maintaining knowledge all contribute to human-centric research in the BPM discipline (Malik et al. 2022). Furthermore, the awareness of human aspects in the BPM discipline reflects the ubiquitous need to consider emerging characteristics of technology and how people in organizations use these characteristics (vom Brocke et al. 2020b). The increasing complexity of the technology application in organizational settings has changed the roles, characteristics, and relationships between humans and technology, emphasizing the joint consideration of social and technical aspects in a hybrid symbiosis.

In light of the three ongoing shifts, we introduce the new nomenclature of BP-x as a signifier for current and future changes in the BPM discipline. Using the term BP-x, we draw on and extend the relevant terminology.

Definition BP-x. The notion of *Business Process “x”* (BP-x) delineates the nascent stream of human-, data-, and technology-driven BPM research. It should be productively used in conjunction with future key categories that arise as a BPM field’s phenomena. Its etymology references the established “x” categories of the field connected to business processes.

The term BP-x has roots in existing vocabulary, such as BPM or BPI. Analogous to the well-known term CAx, which was defined as a “computer-aided tool to support task X” (Shah and Wilson 1989, p.172), the “x” stands for expandability, variability, and openness. While CAx covers various areas of the product lifecycle, such as design, finite element analysis, manufacturing, or production planning (Werner Dankwort et al. 2004), the term BP-x aims to integrate various key categories to analyze and change BPM, which can be part of the business process lifecycle. To provide a better understanding of the commonalities, differences, and forms BP-x can take, Table 1 illustrates exemplary concepts of the dimensions of BP-x.

Preserving the application focus of the BPM discipline, BP-x embodies the applied aspect of process science. By applied, we mean the form that process

Table 1 Exemplary forms of BP-x and corresponding dimensions

Dimension	Concepts from prior literature	Premise
Technology	Business Process: Automation (Scheer et al. 2004; Engel et al. 2022)	Automation refers to the use of technology to streamline, manage, and orchestrate various business processes.
Data	Business Process: Intelligence (Grigori et al. 2004)	Intelligence describes the use of data and analytics tools to gain a deeper understanding of how processes operate and to make data-driven improvements.
	Business Process: Monitoring (Rama-Maneiro et al. 2021)	Monitoring involves the continuous tracking of processes, often using real-time data, to ensure they meet their objectives in future.
Human	Business Process: Management (Dumas et al. 2018)	Management describes the organizational operations to foster effective and efficient processes monitoring of work in organizations to reduce costs and ensure the efficient use of resources.
	Business Process: Modeling (Bandara et al. 2005)	Modeling involves creating visual representations of business processes manually, which can help in process analysis and optimization.
	Business Process: Compliance (Sadiq et al. 2007)	Compliance describes ensuring that processes align with legal and regulatory requirements.

science takes in practice. Despite the reliance on scientific methods, processes, and algorithms, the ultimate aim of introducing BP-x is to achieve a more comprehensive understanding of the involved concepts from a practical standpoint. In essence, BP-x addresses how process science is applied in organizations and is primarily concerned with the integration and application of scientific insights in real-world settings.

3 Theoretical background

To contextualize our proposal, we briefly discuss the theories that influence BPM research and elucidate the theory used as the kernel theory for our artifact design proposal.

3.1 Theories in business process management research

BPM research focuses strongly on theoretical paradigms investigating change, technologies, and the alignment with human factors for organizational success. Thereby, BPM embraces the perspective of processes as an ordering of change (Tsoukas and Chia 2002) that is constantly evolving (vom Brocke et al. 2021a).

To explain the inherent change of processes and internal and external factors that influence change, BPM research uses various theoretical foundations. Examples include investigating the BPM capabilities through the lens of dynamic capability theory (Ortbach et al. 2012), developing a theory for contingent process management (Zelt et al. 2019), or demonstrating the fit of the organization to contingencies that reflect the differences in context and processes (Looy and den Bergh 2018) through the lens of contingency theory.

Another theoretical stream of BPM research elucidates how technology contributes to improved process performance, e.g., by using task-technology fit theory to tackle the challenge of technology-process fit for ambidextrous organizations (Ahmad and Van Looy 2022). Task-technology fit theory is rooted in the IS success model that explains the effects of utilization and user attitude on performance (DeLone and McLean 1992). Beyond the phenomena that emerge with change and technological aspects, BPM research investigates theories with a human-centric lens, e.g., by developing a cognitive BPM theory (de Almeida Rodrigues Gonçalves et al. 2023) for knowledge-intensive processes to consider knowledge exchange between humans.

3.2 Socio-technical theory

To precisely understand and analyze the behavioral aspects of developing and implementing emerging technologies in BP-x initiatives, we consider them a socio-technical system. Thus, we underpin our work with the socio-technical theory.

The origins of socio-technical theory can be traced back to the 1950s (Trist and Bamforth 1951), when the technological imperative dominated and forged the need

for a paradigm change (Trist 1981). This theory originates from general and open systems theory and consequently inherits their core assumptions regarding responsiveness to environment and change (Mumford 2003). Essentially, socio-technical theory acknowledges the social aspects in the iterative process of (re-)designing and intervening in an organization (Bauer and Herder 2009). It posits that success is a product of the continuous interactions and joint optimization of technical and social sub-systems of an organization (Trist 1981). The main principles relate to the nature of interactions and the fit between social and technical factors (Trist 1981).

As a theory for design and action, the socio-technical theory has been applied in various studies, such as IS, organizational, engineering, or management studies (Morris 2009). This theory is operationalized through a process of socio-technical design via interaction between people and technologies (Herbst 1974). In this context, socio-technical design models and methodologies were derived from the three primary dimensions or sub-systems: the social, technical, and environmental. The social sub-system comprises people and their values, relationships, and structure that constitute an organization. In contrast, the technical sub-system comprises tools, techniques, and skills that people need within an organizational setting (Bostrom and Heinen 1977; Trist and Bamforth 1951). Both sub-systems operate within an environmental sub-system, influencing their interactions (Trist 1981).

4 Related work

In data science, organizations use well-established methodologies for data mining, modeling, and prediction. Examples of the methodologies are CRISP-DM, KDD, or SEMMA (Fayyad et al. 1996; Wirth and Hipp 2000; Azevedo and Santos 2008). The goal of these techniques is to provide direction and a coherent process for data-driven projects.

Analogously, there are models guiding data-driven BPM initiatives while acknowledging the distinction between data science and process science. Examples of process mining methodologies are the L*Lifecycle model (van der Aalst et al. 2012), the Process Diagnostic Method (PDM) (Bozkaya et al. 2009), and PM² (van Eck et al. 2015). The L*Lifecycle model covers the automation of BPM lifecycle activities (Dumas et al. 2018), whereas PDM only addresses a limited number of process mining techniques, so it is not suitable for complex projects (Suriadi et al. 2013). Although PM² addresses some limitations and supports projects that specify the goal of process performance or compliance with rules and regulations, it lacks flexibility and practical guidelines (Diba 2019). In summary, existing process mining methodologies only highlight technical aspects and neglect contextual factors (e.g., organizational or cultural) as part of the adoption (Aguirre et al. 2017).

Overall, all methodologies fall short of extending emerging technologies (Beverungen et al. 2021) and provide insufficient guidance at the managerial level (Grisold et al. 2020b). Although there is a great deal of research on data- and technology-driven approaches in the BPM sub-domains, much of it appears to be siloed. The technical sub-domains emphasize technology while neglecting the organizational and human aspects, whereas the managerial and organizational

research bypasses the technical aspects of BPM. Accordingly, we offer a strategy to help managers manage prototypical implementation, instantiation, and associated organizational activity.

5 Research design

DSR signifies the development of innovative solutions for practical problems by generating scientific knowledge. In this context, DSR aims to generate prescriptive knowledge about novel IS artifacts to create means-end-relations between a problem and a solution space (Hevner et al. 2004; Venable 2006). Every DSR project draws on existing knowledge to build new design knowledge by linking the same problem to an adapted solution space (vom Brocke et al. 2020c).

Following design science in IS research (Hevner et al. 2008), we adopt a kernel theory as a basis for deriving general requirements to identify and define solution objectives (Baskerville and Pries-Heje 2010). Hence, for our DSR project, we draw on socio-technical theory (Bostrom and Heinen 1977) to justify our artifact design, explain the interplay between social and technical sub-systems of organizations, and ground our design entities. Within a DSR project, the relation of specific design knowledge can be distinguished in modes (Drechsler and Hevner 2018). Based on the conceptualization of modes, a DSR project can contribute to design knowledge in multiple ways (vom Brocke et al. 2020c; Gregor and Jones 2007). In turn, we use artifact design and real-world application to clarify our understanding of interactions between new design knowledge and the real world (vom Brocke et al. 2020c).

5.1 Overview of design science research process

Our work aims to systematize current trends in BPM research to develop an artifact that guides value creation by accelerating the process toward action. As our core artifact, we propose the *operationalized BP-x management* model that distills prescriptive knowledge about the resources and capabilities that are needed to establish data-driven work. Our IT meta-artifact serves as a solution concept for managers regarding data-driven work in organizations. In doing so, we contribute to the general problem class of creating value from data. For the design of our proposed artifact, we followed the DSR paradigm (Hevner et al. 2004) to design a solution that substantially improves previous work on *managerial* aspects of studying data-driven methods in BPM (Gregor and Hevner 2013). Inspired by the general problem of managing BPM in organizations and informed by specific problems observed in practice, we envision a conceptual IT meta-artifact as a DSR contribution deployed as proof of utility in a real system (Iivari 2015). In doing so, we adapted the DSR methodology of Peffers et al. (2007) using six phases: identifying the motivation and

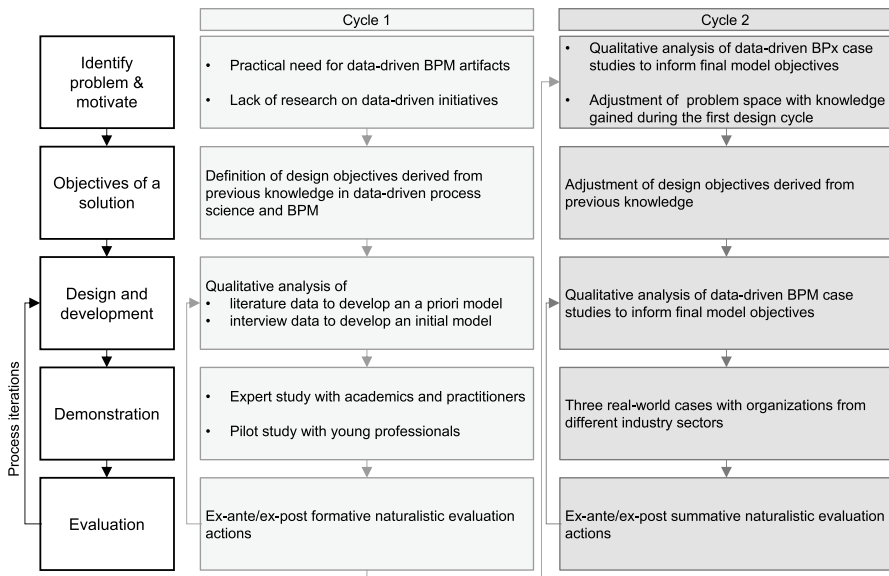


Fig. 2 Research process adapted by Peffers et al. (2007)

the problem, defining the design objectives, designing and developing the artifact, demonstrating, evaluating, and communicating (Fig. 2).

5.2 Overview of first design cycle

The first design cycle began with the definition of the problem space in the *identify and motivate problem* phase. We identified a lack of literature on how organizations use data-driven BPM's various features and capabilities. To remedy the literature's shortcomings, we built on previous design knowledge to derive requirements in the *objectives definition* phase that could be used to develop a solution to the identified problem (vom Brocke et al. 2020c). In doing so, we conducted a structured literature review (SLR) according to vom Brocke et al. (2009) using specific adoption, use, organizational, and management related keywords to collate literature from the data-driven process analytics domain. However, since this literature was limited, we expanded the search to the BPM domain and released the boundary of specific keywords.¹ In the subsequent *design and development* phase, we processed the literature synthesis to draft an inductive qualitative analysis to derive an *a priori* model grounded in literature (Strauss and Corbin 1998). According to Peffers et al. (2007), iterations based on *demonstration* and *evaluation* are a vital characteristic of rigor DSR. Thus, we ran two iterations during the first design cycle²:

¹ See Appendix B for the detailed search procedures including the strings for each database and the exclusion/inclusion criteria.

² Appendix A.1 offers a more in-depth description of the iteration activities throughout the first design cycle.

Iteration 1: SLR to gain a conceptualized understanding and meta-synthesis of the literature on organizational, managerial, and technical concepts that impact the uptake and use of data-driven BPM in organizations; qualitative analysis of literature data; development of a *a priori* model; and expert interviews.

Iteration 2: Qualitative analysis of interview data and expert feedback to acquire a rich understanding of the outputs of the first iteration and alignment of theory and practice; development, demonstration, and evaluation of *initial* model in the pilot study.

The iterations and our *demonstration and evaluation* phase were informed by the FEDS framework (Venable et al. 2016) to “*demonstrate the utility, quality, and efficacy*” (Hevner et al. 2004, p.83) of our proposed model design. Concerning the design, the major risk we faced was user-oriented; thus, our evaluation goal was to measure its utility in real-world situations. Therefore, we decided to use a human risk & effectiveness evaluation strategy (Venable et al. 2016). We performed a formative evaluation covering ex-ante naturalistic evaluation actions (i.e., semi-structured interviews). The evaluation objective was to determine whether the artifact addresses the problem space and justifies the design by fulfilling the evaluation criteria of understandability, real-world fidelity, internal consistency, level of detail, and completeness (Sonnenberg and Vom Brocke 2012). Finally, we performed an *ex-post naturalistic evaluation* with $n=13$ participants in a pilot study to validate reusability (Iivari et al. 2021). The outcome of our first design cycle was the *initial* model grounded in literature and interview data. Section 6.1 provides preliminary insights on the *a priori operationalized BP-x management* model.

5.3 Overview of second design cycle

Despite the relevance identified during evaluation, the results of the pilot study revealed that our artifact could be further improved. We discovered that BP-x initiatives demand a strategy and directive that extends beyond showing the relations between different BP-x constructs. Thus, we initiated a second design cycle and used design knowledge acquired throughout the first cycle as input for the *problem identification and motivation* phase. To ensure targeted further development of our model, we revisited the problem space definition and adapted it to our findings from the first cycle. With this in mind, we reread the BP-x literature, particularly case studies, to better understand how BP-x initiatives are implemented in the industry. Subsequently, we aligned our *solution objectives* with the new state of knowledge and entered the *design and development* phase. At this step, we qualitatively analyzed the empirical data collected from the semi-structured expert interviews. In doing so, we grounded our model redesign in interview and literature data to create a means-end-relation from the observed problems in practice to our model design. Overall, during the second design cycle, we performed two iterations³:

³ Appendix A.2 offers a more in-depth description of the iteration activities throughout the second design cycle.

Iteration 1: Qualitatively analyzing pilot study feedback, revisiting literature review, qualitatively analyzing interview data and expert feedback, and redesigning the *initial* model.

Iteration 2: Model redesign according to expert feedback, evaluation workshops, and the *final* model.

Finally, we conducted a threefold evaluation strategy in the *demonstration and evaluation* phase. In particular, we performed a formative evaluation covering ex-ante and ex-post naturalistic evaluation actions in the form of expert studies and real-world case applications in focus group workshops (Sonnenberg and Vom Brocke 2012) and asked participants to validate reusability via a questionnaire (Iivari et al. 2021).

6 Results

6.1 Results of first design cycle

6.1.1 Problem space and development of the artifact

In the *problem identification and motivation* phase, we first conceptualized the problem space by identifying the corresponding stakeholders and their individual needs and requirements (Maedche et al. 2019). This step was necessary for creating a means-ends relation from the identified problem space and deriving possible artifacts for solving it. Then, based on the problem space, we derived the related core concepts and conducted a SLR (vom Brocke et al. 2009) as a supporting process to ground the *definition of our design objectives* of the artifact on previous knowledge (vom Brocke et al. 2020c). In this process, we searched databases in the research field of computer science, business informatics, and economics to link various knowledge domains across disciplines.⁴

Summarizing the literature review, we identified two main starting points for the artifact design. On the one hand, we observed that the academic literature considers BP-x through three different lenses: technical, organizational, and managerial. On the other hand, we discovered a disconnect between previous management-focused BPM research and new BP-x technology approaches. Therefore, we followed the grounded theory methodology during *designing and developing* and used the concepts synthesized during the SLR to identify functional constructs for model building (Strauss and Corbin 1998; Wolfswinkel et al. 2013). According to the grounded theory's procedure, our analysis was guided by three coding stages: (1) open coding, (2) axial coding, and (3) selective coding.

Table 2 shows the preliminary outputs based on literature data of the first design cycle iteration. The managerial, technological, and organizational perspectives were the primary structures to derive higher-level model constructs in the upcoming iteration. We re-structured the *a priori* components by aligning the expert feedback with

⁴ The detailed search proceeding including strings for each database and exclusion/inclusion criteria is described in Appendix B.

Table 2 Components of *a priori* model with exemplary literature

Organizational perspective	People
	Individual BP-x skill set and trainings (1, 9, 20, 21)
	Process education and training for process participants (19)
	Knowledge management (11)
	Change management (7, 20)
	Change awareness (1, 2, 4, 10, 13, 14, 17, 18, 21)
	Cross-departmental collaboration (2, 11, 13, 15, 19)
	Clear communication of projects and goals (1, 14, 15, 18)
	Data quality awareness (5, 9)
	Stakeholder and people involvement (1, 9)
	Management support (1, 2, 9, 11)
	Process awareness (2, 4, 5, 7, 17, 18, 21)
	Transparency on data capture, use and storage (5, 8)
	Decision making (2, 11, 14, 15)
	Data governance (4, 8, 9, 10, 16, 21)
	Roles and accountabilities (2, 4, 10, 11, 14, 15, 17, 21)
	Legislation and compliance (2, 4, 7, 8, 14, 18)
	Definition of process-centric strategy (1, 4, 13, 15, 14, 21)
	Strategic fundamentals (2, 4, 9, 10, 13, 14, 16, 21)
	Strategic measurements (1, 2, 4, 7, 12, 13, 17, 18, 21)
	Strategic process alignment (1, 2, 4, 10, 13, 14, 15, 17, 18, 19, 21)
Strategy Alignment	

Table 2 (continued)

Technological perspective	Personalizability	AI, RPA (5, 12, 18)
	Scalability	Cloud computing, real-time computing (6)
Managerial perspective	Sociomaterial	IoT (6, 8)
	Traceability	Blockchain, big data analytics (6, 8, 10, 16)
	Ubiquity	Smart devices (8)
	Virtualizability	Computer vision (5)
	Strategical focus	Define business value (7, 10, 11, 12)
		Define goals (7, 10, 11, 20)
	Tactical focus	Plan and initialize (3, 7, 9, 11)
		Augmentation (7)
		Descriptive Analytics (10)
		Extract (5, 6)
Operational focus	Monitoring and Controlling	(3, 10, 13)
		Automation (12)
	Prediction	(3, 6)
Process Change (7, 10, 14)		Prescription (3, 6, 12)

Sources: (1) Beckett and Myers (2018); (2) Dharmawan et al. (2019); (3) Drakouloukonas and Apostolou (2021); (4) Kerpedzhiev et al. (2021); (5) Kratsch et al. (2022); (6) Krumeich et al. (2016); (7) Malinova et al. (2014); (8) Mannhardt et al. (2018); (9) Mans et al. (2013); (10) Mendling et al. (2018); (11) Niehaves and Henser (2011); (12) Padella et al. (2022); (13) Plattfauf et al. (2011); (14) Röglinger et al. (2022); (15) Rosemann and Vom Brocke (2015); (16) Rott and Böhm (2022); (17) Škrinjar and Trkman (2013); (18) Takeuchi and Yamamoto (2020); (19) Pflanzl and Vossen (2014); (20) Szelagowski and Berniak-Woźny (2020); (21) Kerpedzhiev et al. (2021)

Table 3 Experts interviewed during the first design cycle

ID	Current position	Work experience (years)	Industry	Industry sector	Company size
I1	CEO	4–7	Process Analytics	Information services	< 10
I2	Consultant BPM	4–7	Retail	Services	> 5000
I3	CTO	1–3	Software Development	Information services	< 10
I4	Managing Director	7–10	Software Development	Information services	10–50
I5	CEO	> 20	Software Development	Information services	10–50
I6	SAP Consultant	4–7	IT Consulting	Information services	250–1000
I7	Researcher	4–7	Research	Information services	1000–5000
I8	Partner & Director	10–15	IT Consulting	Manufacturing	1000–5000
I9	Researcher	4–7	Research	Information services	< 10
I10	Manager Business Consulting Banking	15–20	Business Consulting	Services	> 5000
I11	Team Lead BPM	10–15	Retail	Services	> 5000

theory to an initial model design. Thus, the *a priori model* components are input for developing the *initial* model in the second iteration of the first design cycle.

6.1.2 Evaluation activities and results

Expert interviews: We performed an *ex-ante naturalistic evaluation* by conducting $n=11$ semi-structured interviews with academic and practitioner experts in BPM and PM. We started the interviews with a preliminary questionnaire to gather the participants' demographic information (Table 3). Subsequently, we followed a three-step interview guideline: (1) general questions, (2) management, strategy, and use of BP-x in the organization, and (3) model validation. We presented the model design to the participants and asked for their perceptions during the model validation process. We also asked whether they would alter the sequence of the model's components or modify, add, or remove any elements. Notably, we interviewed representatives of different organizations and experts individually to minimize bias.

Overall, experts approved the relevance and novelty of our research, as many organizations face the pressure to move in the direction of BP-x to leverage the value propositions of data and technology. All experts appreciated the development of a comprehensive model that captures the opportunities of digitalization in alignment with BP-x. In the course of the interviews, experts also identified improvement potential as well as challenges regarding applicability. The following are the most significant findings from the expert interviews.⁵ Regarding *understandability*, the experts confirmed that the model is comprehensible for practitioners with prior knowledge of process analytics (e.g., I2-6). Concerning *real-world fidelity*, all of the

⁵ Appendix C.1 provides an overview of the interview guidelines, and Appendix A.1 describes the model design iterations, where we incorporated the feedback.

experts verified that the model addresses a problem in practice and offers a workable solution. As for *internal consistency* and *completeness*, the participants noted a high degree of coverage of the respective procedures, tools, and techniques. However, they highlighted improvement potential regarding the *level of detail* because the model was overly complex.

Pilot study: After two iterations, we concluded the first cycle with a pilot study to summatively and quantitatively evaluate whether our current model design is reusable (Venable et al. 2016). In doing so, we followed Iivari et al. (2021) suggestions for evaluating reusability. The pilot testing of our model design covered a half-day workshop with three phases. We explained the model to the participants in the first phase and introduced a real-world organization use case. During the second phase, we allocated the participants into three groups to work on the use case and apply our model. Finally, in the third phase, we asked the attendees to comment on the model's comprehensibility and about whether they would modify, add, restructure, or remove model components. After the application and discussion of the model, we asked all participants to fill in a questionnaire to retrieve their demographic information and their perception of the reusability. Thereby, we obtained quantitative data about perceived usefulness via the questionnaire and gained additional qualitative insights during the discussion.⁶

6.2 Results of second design cycle

6.2.1 Redefining the problem and redesigning the artifact

The results of the summative evaluation of the first design cycle indicated further improvement potential regarding the complexity and applicability of our model. Thus, we initiated a second design cycle by revisiting the literature and focusing mainly on the use of data-driven BPM technologies. In particular, in the *identify problem & motivate* phase, we reviewed case studies to get a deeper understanding of how BP-x initiatives are conducted in practice. This helped us clarify our previous *objectives* concerning our envisioned artifact. Managers must rely on proven methods, techniques, and tools to foster a common understanding of the actual performance of business processes and drive business process optimization through data and analytics. Therefore, our model should serve as an actionable prescription for systematically implementing BP-x initiatives. Since BP-x activities can be implemented across organizations, business cases are influenced by different stakeholders, roles, goals, objectives, data, and related capabilities. These insights guided our subsequent *design and development* phase. We present our final *operationalized BP-x management* model in Sect. 7 in connection to the literature and interview data.

In the vein of the *design and development* phase, we qualitatively analyzed our interview data conforming to the principles of grounded theory (Strauss and Corbin 1998; Charmaz et al. 2012). The *open coding* activities led to approximately $n=140$ open codes discussed among the researchers and used to derive a standard coding

⁶ We provide details on the pilot study setting and the questionnaire in Appendix C.2 and Appendix C.3.

Table 4 Examples of open coding

Open code	Illustrative example
Sensor data to enrich process-aware data	“Technically, it then ends up being multi-level, chained programs or APIs from which one can derive and collect various data from machines in order to then deliver appropriately programmed suggestions.” (I8)
Human process knowledge	“It is an iterative procedure to draw conclusions about the status quo of the processes in a data-supported and objective way. And from the status quo, one then generates insights. Where are the great strengths of consultants, both internal and external, or of specialist employees? They know the processes extremely well and are experts in certain things, especially when it comes to optimization.” (I1)
Inter-organizational collaboration using Blockchain	“Adopting process mining tends to be more attractive for companies if you keep the data internally first. Blockchain is an inter-organizational technology where you have to think more about what data you’re giving out and how you’re handling it and whether the data is really applicable.” (I9)
Perceived value of process visualizations	“Process management itself is always very difficult to sell to people. With lean management, it’s a bit easier because you can start with weak points and wastage and people quickly understand that. That’s better than modeling a process model, because people often don’t understand why you need it. With process mining it is even better, this is my experience now, [...] that the departments can be inspired very quickly with the topic, because they then see what kind of analyses they get and they quickly see an added value.” (I2)

scheme. The repeated discussion of the codes among the co-authors resulted in about $n=50$ codes as the output of the *open coding* phase. Table 4 illustrates exemplary open code results.

In light of our research question, we then synthesized codes during *axial coding* into high-level code categories (Table 5).

Specifically, we synthesized patterns and organized all open coding results into a common scheme based on the open coding results of each individual researcher. Subsequently, in an extensive workshop, the researchers separately coded high-level code categories and discussed them in light of the literature and interview data to create constructs forming the model’s stages. We identified six major constructs that provide procedural guidance in BP-x initiatives: incentive, initialization, data, capabilities, action, and outcome. Furthermore, we specified three categories of critical enablers: technology, organization, and ecosystem. We identified strategic alignment as particularly important in supporting all of the determined constructs. Finally, during *selective coding*, we integrated the axial codes into the theoretical constructs

Table 5 Examples of axial code

Axial code	Category	Sub-category
Organization	Structure	Organization size Centers of excellence Organizational effects of BP-x BPM department External Consulting
Initialization	Planning	BP-x as an IT project Missing plan for roll out Project-based PoC Pilot projects Structured approach toward BP-x needed Domain-specific context of projects Prioritization and selection of business case
Strategic Alignment	BP-x Strategy	BP-x as tool for strategy enhancement Need for BP-x Strategy Strategy as prevention of failure

identified in the first design cycle. See Appendix D for more information on coding activities conforming to Strauss and Corbin (1998).

6.2.2 Reusability evaluation through real-world application

Our evaluation strategy in the second design cycle was threefold, namely (1) expert interview study, (2) real-world application in workshops, and (3) quantitative evaluation of reusability after application.

First, we conducted an expert study with $n=8$ BPM experts who experienced or managed data-driven BP-x initiatives. We stopped conducting interviews after observing theoretical saturation (Strauss and Corbin 1998). Consistent with the semi-structured expert interviews of the first design cycle, we used a preliminary questionnaire to gather the participants' demographic information, which is summarized in Table 6.

Subsequently, we guided participants through a three-step interview guideline (see Sect. 6.1.2 or Appendix C.1 for more details). The following are the key findings from the expert interviews. All of the participants considered the model *understandable* and *complete*, as it provides an understanding of the different components required for BP-x initiatives. The participants highlighted the high *real-world fidelity* and appreciated the presence of enablers and the inclusion of strategical alignment. After the final design and development phase, all of the participants approved the *completeness* and *internal consistency* of our model. In particular, they highlighted the applicability of our model and valued the *level of detail* as adequate for a management perspective.

After incorporating feedback and refining the artifact design, we performed our second evaluation activity to measure the artifacts' applicability in real-world cases via focus group workshops (Sonnenberg and Vom Brocke 2012). Specifically, the

Table 6 Overview of the experts interviewed during the second design cycle

ID	Current position	Work experience	Industry	Industry sector	Company size
I12	Head of Product Management & Customer Success	10–15 years	Software Development	Information services	50–250
I13	Team Lead SAP Development	10–15 years	Retail	Services	1000–5000
I14	Professor/Vice President	> 20 years	Research	Human services	250–1000
I15	Managing Consultant	7–10 years	Business Consulting	Information services	50–250
I16	Business Analyst	1–3 years	IT Consulting	Services	> 5000
I17	Lead Consultant	15–20 years	IT Consulting	Information services	50–250
I18	CEO	4–7 years	Retail	Manufacturing	50–250
I19	Team Lead Process Management & Project Management	15–20 years	Business Consulting	Information services	250–1000

real-world application of our model took place within half-day workshops with three different organizations from different industry sectors (a food and non-food retailer, a multinational automotive manufacturer, and a low-code software platform vendor). Each organization applied the model to its previously selected use case. During the workshop, we explained the model and provided the opportunity to apply the model and subsequently think about the corresponding model design.

Finally, we invited the workshop participants to assess the *operationalized BP-x management* model according to the reusability evaluation criteria of Iivari et al. (2021). We created a questionnaire that each attendee answered separately and anonymously to reduce group bias and encourage straightforwardness in answering the questions. We provide details on the workshop setting and the evaluation results in Sect. 8. Further information concerning the questionnaire is provided in Appendix C.3.

7 Final operationalized BP-x management model

Embracing the new world created by technological advancements, organizations need guidance on developing BP-x initiatives to leverage future potentials and opportunities for organizational success. Grounded in literature and interview data, we propose an agile procedure for establishing and maintaining process and data-driven work. The model that we developed helps organizations, particularly managers, progress in defined focus areas of BPM and serves as a guide for navigating forward in the endeavor of data-driven work (Fig. 3).

In doing so, the model aims to provide a holistic view of the means-end-relations of BP-x and specifically addresses organizations that are already process-oriented and need a strategic directive for data- and technology-driven approaches. Originating from the project-proceeding, our model empowers organizations to embrace data-driven working in line with external and internal organizational structures and processes. Adhering to the credo from insights to action, organizations that want to start operationalizing BP-x work through six stages: incentive, initialization, data, capabilities, action, and outcome. Throughout all of these stages, our model proposes a continuous alignment with existing corporate strategies and highlights the enabler of BP-x initiatives as a fundamental prerequisite.

The support stages of strategic alignment and enablers play a critical role in BP-x initiatives due to their ability to jointly optimize both technical and social aspects. By focusing on outcome-driven performance and efficiency gains while simultaneously fostering the creation of new revenue models aligned with the concept of ambidextrous organizations (Ahmad and Van Looy 2022), BP-x initiatives should aim for sustainable success. The support stages of strategic alignment and enablers highlight the interconnectedness of the internal and external (strategic) implications and the reciprocal influence of enablers on initiatives and vice versa, thereby showcasing the holistic nature of BP-x implementation.

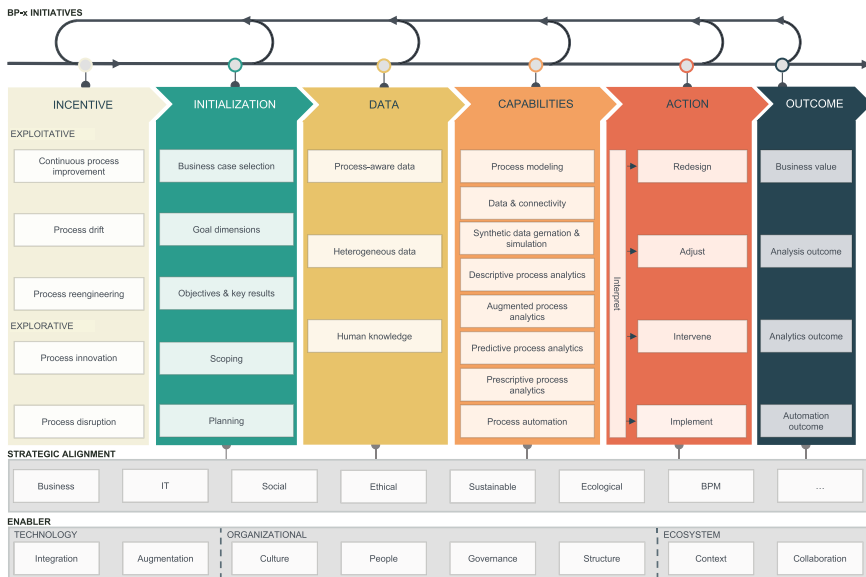


Fig. 3 Final operationalized BP-x management model

7.1 Incentive

Organizations have multifaceted motivations to cause or conduct BP-x initiatives. The stage *incentive* discusses the reasons and motivations behind starting BP-x initiatives. From a management perspective, the incentive to initiate shapes future BP-x activities, such as the requirements and capabilities needed to implement process change (I18). Organizations are primarily performance-driven; therefore, managers often aim for *continuous process improvement* or *process reengineering* to solve problems, such as lack of transparency, inefficiency, or high costs (Malinova et al. 2014), (I1,I3,I14,I16). Beyond improving and reengineering processes, there can be other plausible reasons to initiate BP-x endeavors. Academic research distinguishes between *exploitation*, i.e., incremental process improvement, and *exploration*, i.e., the radical (re-)design of processes (vom Brocke et al. 2020a). Examples of explorative incentives are *process innovation* or *process disruption* that amplify the numerous reasons to leverage data as an activator for value contribution. Thus, organizations should not simply aim for business process exploitation but rather seize the opportunities from explorative BP-x, such as *process innovation* (Grisold et al. 2022, 2021). Driven by the increasingly dynamic business world, an organization's success depends on its ability to adapt to external changes proactively (Brönnimann 2020). Hence, BP-x initiatives should account for exogenous shocks that might impact the organization's value proposition (Röglinger et al. 2022).

7.2 Initialization

Once the motives for BP-x initiatives have been clarified, the objective of the *initialization* determines a business case and the corresponding goal dimensions, objectives & key results, and scope. Subsequently, the concretization of a project begins in the planning step. The *initialization* stage serves as a framework that shapes the focus of upcoming stages and activities.

Business case selection: A BP-x initiative generally starts with understanding the domain in cooperation with process owners, participants, and stakeholders to select a viable business case for analysis (e.g., Wanner et al. 2019; Fischer et al. 2021, I1-3). Depending on the degree of digitalization and the presence of BPM, an organization relies on either manual process documentation or digital trace data to prioritize and select a potential business case (I1,I3). During this activity, the organization has to identify the corresponding *goal dimension* and translate them into *objectives & key results* to set a *scope* for the initiative.

Goal dimensions: Narrowing down the primary goals of a BP-x effort guides subsequent activities and stages to unlock business value (I2,I9). A concise understanding of the goals leads to success and support evaluation. For example, organizations typically attempt to optimize their processes, but there are intermediate goals (e.g., process identification or standardization) that ultimately lead to the goal of process optimization and improvement (I10,I12).

Objectives & key results: Defining *objectives & key results* links the BP-x goal dimensions with the goals and vision of an organization. At the same time, this definition builds a means-end-relation to future outcomes by answering what the initiative hopes to achieve and what the outcomes and deliverables should be. Finally, the answers are the ends that lead to developing key performance indicators (KPIs) as quantifiable measures for monitoring progress (I4,I5).

Scope: By assembling the goals and objectives to articulate what an initiative involves, the *scope* statement delineates the unit of analysis for the envisaged BP-x initiative. The scope statement subsumes two activities. First, the impacts of an initiative are determined to specify the deliverable's capabilities, features, and functions. The second task involves understanding the project setup type to extract requirements, restrictions, and risks. The former addresses three abstraction levels of impact on organizational processes, ranging from operational to strategic (e.g., Zerbino et al. 2021, I17), while the latter delivers inputs for planning and management. Regarding project setup types, we distinguish between creating a proof of concept (PoC) and pilot projects because we consider pilot projects to be projects that can be rolled out and scaled across entire organizations (I11,I16). In contrast, PoC merely involves technical and functional feasibility tests that a narrow group of employees in a specific department conduct to demonstrate utility. Accordingly, pilot projects are project-based BP-x implementations that serve as risk identification and have the potential to develop preliminary high-level project plan components and best practices prior to roll out.

Planning: Finally, the *planning* step includes project set up, such as budgeting (I6,I8,I14), determining roles and responsibilities (e.g., Rott and Böhm 2022, I6), or tool selection (e.g., Drakoulogkonas and Apostolou 2021). An appropriate project

management methodology should be selected depending on the organization's culture and structure (I1,I3,I6,I8,I10).

7.3 Data

Data constitute the foundation of BP-x initiatives. As a direct consequence, organizations must address the issue of data availability in light of their analysis goals. Thus, there is a strong emphasis on data acquisition and exploration, which involves data collection, cleaning, and preparation for analysis using appropriate BP-x tools. A study of the data at hand is needed to determine where to enter in data-driven BPM. As noted, "*By understanding the data [...], you have so much information that you can cover the future topics much better*"(I1). However, the data-entry capability is affected by the degree of digitization. There are four cases to distinguish: (1) there is no digital data, and everything is done manually, (2) there is a digital mapping of manual tasks, (3) process-aware data is logged in information systems, and (4) there is access to context data, such as sensor or video data (e.g., Kratsch et al. 2022; Krumeich et al. 2016; Oberdorf et al. 2022). As a result, the *data* stage primarily engages with input data types, laying the foundation for data-entry capabilities. The input data types can be classified into process-aware data, heterogeneous data, and human knowledge.

Human knowledge includes human expert knowledge that can be used to augment process data (Beerepoot et al. 2023; Santoro et al. 2010), (I1,I17) or to create formalized models, such as process models (EPK, BPMN), or decision models (DMN, OD) (Object Management Group 2022, 2016; Carr 2017) for conformance checking (van der Aalst et al. 2012; Munoz-Gama et al. 2016; van der Aalst et al. 2015; Leemans et al. 2023).

Process-aware data incorporates data that stem from IS and depicts processes on different granularity levels (Koschmider et al. 2018). Usually, digitalized organizations have access to low-level event log data from process-aware enterprise applications (van der Aalst et al. 2012; van der Aalst 2019). Besides data from process-aware IS, data with a higher granularity level enrich the data-entry capability. For instance, high-level data covers complex event data from event-driven systems (Krumeich et al. 2015; Mayr et al. 2022b), IoT and Blockchain application data (Janiesch et al. 2017; Beverungen et al. 2021), user interaction data (e.g., click-streams) (Linn et al. 2018; Mayr et al. 2022a), (I1,I3), or social media user tracking data (Li and De Carvalho 2019; Diamantini et al. 2017). Depending on the business case and BP-x goal, high-level data enrich process analytics capabilities and analysis perspective. Furthermore, some data cannot be directly assigned to process activities but represent the process environment.

Heterogeneous data include non-process related data. Especially in the case of advanced process analytics, unstructured or structured process context data can potentially improve analysis results (Oberdorf et al. 2022), (I8). Examples of heterogeneous data are sensor data, mail, documents, videos, or audio.

7.4 Capabilities

The *capabilities* stage describes the technological capabilities needed to shape the road map for insights and process control generated by BP-x initiatives. The joint core element of BP-x capabilities covers eight capability areas that are related to numerous methods and techniques. Process analysts must cope with diverse capability areas depending on the goal dimension. Therefore, the areas range from manual process modeling to decision-support based on advanced process analytics, such as prescriptive process analytics.

Process modeling: The most prevalent approach in theory and practice is business process modeling (I1,I8), which allows companies to manage, analyze and adapt their processes in a digital form but in a mostly manual way (Niehaves and Henser 2011; Petcu and Stankovski 2012). Although process modeling is not inherently data-driven, it can form the foundation for data-driven BP-x initiatives, such as process conformance checking or planning decision-support systems. Process modeling initially draws from ideas related to manual modeling activities, whereas some modeling techniques leverage the benefits of data. Those techniques comprise decision modeling (e.g., Object Management Group 2022; Hasić et al. 2018; De Smedt et al. 2019) or case modeling (e.g., Object Management Group 2016; Wiemuth et al. 2017).

Data & connectivity: While the *data* stage outlines the different input data types, *data & connectivity* captures the data-entry capability. This involves knowledge about data standards, infrastructure, or API management to establish and ensure data availability as needed. Thus, the scope of this capability area ranges from data extraction to establishing connectivity for real-time data handling and operational decision-making support. Likewise, the data-entry capability will extend to new techniques, such as capturing data in the form of desktop activity mining (I1,I3). In summary, data-entry capability and concerned expertise is a prerequisite for BP-x initiatives to realize their full potential (I10,I16).

Descriptive process analytics: The capability area of *descriptive process analytics* refers to techniques that describe and analyze the as-is processes and how they are interrelated. The intention is to provide an ex-post explanation of how, why, and when certain process phenomena occur. An illustrative example is process mining, which is an automated and data-driven technique for discovering as-is processes. The scope of the capability area ranges from real-time monitoring and continuous analyzing data to deriving quantitative process metrics in light of BP-x initiative objectives. Beyond the three main pillars of process mining (van der Aalst et al. 2012), the capability area also extends to novel descriptive techniques, such as object-centric process mining (Li and De Carvalho 2019).

Augmented process analytics: Augmentation describes the creation of integrated process analysis and augmentation with context- and resource awareness, i.e., either completion or enrichment of process-aware data. Thus, *augmented process analytics* find their application if process models do not accurately represent reality or if it requires a contextual extension to achieve the analytical goal (Beerepoot et al. 2023). As there is a growing number of possibilities for process mining results and

models to be enhanced with common sense, additional data, domain knowledge, and AI, we curated this effort as a separate BP-x capability area (Dumas et al. 2022).

Predictive process analytics: The capability area *predictive process analytics* involves the capability to identify what process changes will occur under certain conditions (Schwegmann et al. 2013; Fülöp et al. 2012). In particular, it includes BP-x solutions to ex-ante monitor process stability and optimization potential (Krumeich et al. 2016). As a result, predictive capability enables organizations to respond proactively to business events and changes. Application examples range from predicting the next activities (Pravilovic et al. 2014) to predicting process disruptions (Oberdorf et al. 2022). Furthermore, regarding predictions, novel techniques, such as explainability of model predictions, extend the scope of this capability area (Sindhgatta et al. 2020; Mehdiyev and Fettke 2020).

Prescriptive process analytics: Monitoring the future enables the development of value from data; however, *prescriptive* capabilities can magnify this effect by providing explicit prescriptions for executing activities. More specifically, the appropriate course of action for minimizing or optimizing specific key performance indicators is recommended based on monitoring the future (Krumeich et al. 2016). While prescriptive capabilities can be acquired through optimization, the explainability of predictive models is becoming increasingly important for deriving prescriptions (e.g., Mehdiyev and Fettke 2020).

Synthetic data generation & simulation: Capabilities related to the core capability area of *synthetic data generation & simulation* embrace the upcoming data science-related techniques related to data generation and simulation (Martin et al. 2015; van der Aalst 2018). This refers to the process of creating artificial datasets that mimic real data. The primary purpose is artificial evaluation for algorithm development, benchmarking algorithms, or data augmentation. While simulation is the most common way to produce synthetic data, using mathematical or generative models is an equally viable option (e.g., Goodfellow et al. 2014; Wan et al. 2017; Camargo et al. 2021). One of the main advantages of synthetic data is that they allow for the creation of diverse and large data sets, even for domains where collecting accurate data is difficult to obtain, privacy protected, or expensive (I10).

Process automation: The capability area *process automation* encompasses the industrial reaction to managers' efficiency reasoning in the face of the long tail of processes (Imgrund et al. 2017), (I1-5,I8). As interest in automating activities or tasks within business processes grows, process automation and process analytics naturally converge toward hyperautomation (Herm et al. 2022). On the one hand, data-driven process insights can act as accelerators for process redesign and automation decisions (I1,I3). On the other hand, process analytics insights can be applied to evaluate the performance of automation solutions in an increasingly automated environment. Process automation encompasses RPA and numerous hyperautomation techniques such as chatbots, API automation, and workflow automation.

We attempt to offer a comprehensive representation of BP-x capabilities to date, but we recognize that it will evolve further through research and innovation. For this reason, we have introduced BP-x nomenclature to account for extensibility.

7.5 Action

The *action* stage focuses on implementing changes to achieve the desired goals using different BP-x capabilities. As guidance, we synthesize the following from established BPM approaches (e.g., Dumas et al. 2018; van der Aalst 2011; Lux et al. 2013).

Depending on the goal dimension and BP-x capabilities applied, the results and their *interpretation* will change based on the data used (i.e., post-hoc or ex-ante). In comparison, the analysis of descriptive and augmented process analytics starts at model level (e.g., Cho et al. 2017; Malinova et al. 2022; Martin et al. 2021), while the interpretation of predictive and prescriptive process analytics targets the process instance level (Krumeich et al. 2016). Conditional on the interpretation, change can unfold in different facets. Induced by analytical insights on process model level, *process redesign* refers to a significant process change, whereas the *adjustment* of a process represents a less invasive and sometimes temporary process change (e.g., van der Aalst 2011). In contrast, *process intervention* describes the ad-hoc action to change the course of a process by proactively interfering at process instance level (e.g., Krumeich et al. 2016; van der Aalst 2011). The transformation of a process into a to-be process using organizational measures or BP-x capabilities refers to the *implementation* of process change (e.g., Malinova et al. 2014; Mathiesen et al. 2011; Ortbach et al. 2012). Even though we do not explicitly mention the evaluation of change types, we see it as an implicit prerequisite before adaptation (e.g., Malinova et al. 2022; Mendling et al. 2018, 2020), (I5).

Organizations can leverage these four variations of change to manage and modify their business operations either reactively or proactively (e.g., Dumas et al. 2018; Krumeich et al. 2016). If organizations only take a reactive approach, innovations, exogenous shocks, or process drift triggers process change (e.g., Mendling et al. 2020; Röglinger et al. 2022). Conversely, proactive change leverages insights into the future to avert foreseeable problems before they materialize. Many organizations currently initiate the changes manually, but with emerging and increased use of BP-x technologies, these process changes can be automated in the future (e.g., Krumeich et al. 2016), (I10).

7.6 Outcome

The stage *outcome* illustrates the gains a given BP-x initiative shall achieve. This stage directs users to specify the benefits from a managerial point of view, which increases endorsement by highlighting the initiative's importance (Rosemann 2014; Eggers and Hein 2020). We divide the outcome into four categories: the overall business value, the analysis and analytical outcome, and the automation outcome.

The *business value* expresses possible process efficiencies gained that unfold either monetarily or non-monetarily (Badakhshan et al. 2022; Eggers and Hein 2020). Examples include faster execution time or lower error rate (I14,I15) and qualitative or quantitative advantages on process or products (W1,I16), as well as impacts on the business model (I4,I5). Externally business value creation directs the needs

of share- and stakeholders, such as customers or vendors, and internally it addresses security or compliance issues (Badakhshan et al. 2022). Business values establish on measurable criteria and intertwine outcomes to the goals and, objectives & key results defined in the initialization stage.

Especially as “[...]departments are then very quickly inspired by the topic or with the topic because they then see what kind of reports they suddenly get, and they see fast and added value” (I2), we also encourage users to define the outcome on a more technical level. It is particularly relevant to specify the expectations of the beneficiaries beforehand to address them better in the developmental stage. BP-x initiatives can result in various *analysis outcomes* such as process visualizations, KPIs, business process models, decision models, process maps, and organizational models. Given the use of more sophisticated and complex BP-x capabilities, such as predictive or prescriptive process analytics, the definition of the users’ expected *analytics outcome* becomes more relevant. The comprehensiveness and understandability of predictions and recommendations and the requirements for their daily use should be addressed. Automation has multiple forms. There is a vast range of possible outcomes for automation initiatives, from single-task automation to end-to-end process automation, up to a holistic strategic automation alignment. Therefore, there is an inherent need to define the expected *automation outcome* to draw the right capabilities when creating a hyperautomated organization (van der Aalst et al. 2018; Madakam et al. 2022; Haleem et al. 2021).

7.7 Enablers

Enablers represent the critical factors that organizations need to successfully embed BP-x and reinforce the strategic intent of process and corporate goals. Understanding and managing enablers during BP-x initiatives set the foundation for long-term sustainable success. To thrive on the uptake, organizations need to consider which existing organizational, technological, and ecosystem capabilities will act as core enablers for BP-x initiatives.

Technology: Two distinct technology types enable the application of BP-x and data-entry capabilities. Both form the new technological conditions and requirements of BP-x systems. The first type encompasses technologies with the characteristic integration (I3,I9). *Integration* technologies change the system landscape, facilitate new ways of process contextualization, and serve the request for BP-x to be socio-material (I8), ubiquitous (I8), scalable (I1), or interoperable (I3) (vom Brocke et al. 2022). Examples are IoT for collecting sensor data (Janiesch et al. 2017), smart devices (Mannhardt et al. 2018), cloud computing (Roeglinger et al. 2018), or orchestration with RPA (Reijers 2021). The second technology type includes emerging technologies that augment BP-x activities and unlock new potentials. *Augmentation* technologies complement them to take BP-x to the next level and serve the demand for BP-x to be personalized (I4), virtualized (I19), or traceable (I9) (vom Brocke et al. 2022). Examples are AI (Kratsch et al. 2022), automation (Padella et al. 2022), or Blockchain (Mendling et al. 2018).

Organization: The second core enabler of BP-x initiatives is the organizational environment. For an organizational instantiation of BP-x initiatives beyond the pure prototypical implementation of a PoC and pilot project, the organizational structure needs to be integrated (I6,I8,I13). On the one hand, the procedure has to fit the organization's culture; on the other hand, the procedure has to involve the people. Any changes and influences on the organizational structure and governance should also be considered (I6,I14).

Culture in organizations includes collective values and beliefs that guide behavior toward BP-x initiatives to achieve business performance. To establish a culture of BPM, it is important to consider the CERT values: customer orientation, excellence, responsibility, and teamwork (Schmiedel et al. 2013). These values help define the cultural elements necessary to implement a successful BPM culture. Essential elements of a BP-x-supportive culture are top management support (Imgrund et al. 2021), (I14), awareness of change and processes (e.g., Plattfaut et al. 2011; Kerpedzhiev et al. 2021), or transparency (e.g., Mannhardt et al. 2018) in data collection, storage, and analysis (I2,I4). As with BPM endeavors, BP-x initiatives require clear organizational communication along with involvement and alignment with the stakeholders' needs (e.g., Beckett and Myers 2018; Froger et al. 2019). Without clear communication of BP-x initiatives and goals, the organizational culture may not internalize its importance (I1, I9, I13).

People describes enhancing business performance through the continuous investment in human resources at an individual or group level. Facing the developments from disciplines newly connected to BPM, new capability areas need to be established in organizations including data, innovation, customer, and digital literacy (Kerpedzhiev et al. 2021). On the individual level, the training and education of process analysts and participants play a paramount role (e.g., Mans et al. 2013; Malinova and Mendling 2018; Kerpedzhiev et al. 2021), (I12). For example, advanced training on emerging technologies in BP-x technologies (I13). On the group level, knowledge and change management are vital for the sustainable organizational embedding of BP-x (Niehaves and Henser 2011; Beckett and Myers 2018), (I2,8).

Governance involves the capability to manage the risks associated with BP-x by providing guidelines and structure (W1, 2). Examples include defining roles and responsibilities (I14) or providing guidelines to comply with regulations regarding data collection and handling (Goel et al. 2021), (I4,17).

Structures include the way in which organizations or companies integrate BP-x initiatives. A starting point is working on time-limited projects in cooperation with process owners (I1,I2,I4,I12). To operationalize BP-x, organizations need structures for the continuous department support and promotion of BP-x. In practice, establishing central centers of excellence has proven successful for larger organizations (Galic G. and Wolf M. 2021), (I2-6,I8-9,I13-14,I16-17).

Ecosystem: Future BP-x initiatives might not only span intra-organizational endeavors but encompass inter-organizational *collaboration* across boundaries (Martin et al. 2021; vom Brocke et al. 2021b), (I9). The ecosystem of a company includes the network in which it operates and the property that each unit in the ecosystem influences and is influenced by the others. *Business context* factors influence process design and analytics, and organizations need to understand how to navigate

in this environment (vom Brocke et al. 2020a), (I10). Recognizing the ecosystem helps organizations delineate and enrich BP-x initiatives (I14).

7.8 Strategic alignment

The impact and success of BP-x initiatives in an organization depends on the *strategic alignment* that aims to link the organizational priorities and BP-x initiatives to promote organizational embedding from the beginning (Herm et al. 2022; Martin et al. 2021). Organizations often view strategic alignment through the lens of information technology supporting business strategy (Tallon et al. 2016). Meanwhile, BP-x initiatives in organizations also need to be aligned with the overall business strategy (Martin et al. 2021; Suša Vugec et al. 2020; Grisold et al. 2021), (I12, W1). This includes the management, design, and execution of BP-x activities in line with corporate goals. As noted, “*You need certain guidelines, and if you want to actively establish and pursue [BP-x] as a company, then you have to record it cleanly and also pursue it cleanly in the strategy*” (I8). Even though alignment is acknowledged as a critical success factor of BP-x initiatives, many organizations address the technical and conceptual challenges of BP-x initiatives before addressing the strategic challenges (I10, I14, I16, I17). This can cause initiatives to fail (I8), for instance, if initiatives do not contribute value to corporate goals (I13) or organizational embedding is missing (I8). To achieve the desired performance, it is advisable to introduce BP-x as a PoC or pilot project to attract interest and demonstrate the added value (I2,I9,I15,I19).

8 Evaluation of the final model design

Our summative naturalistic evaluation, which concludes the second design cycle, comprises three evaluation activities guided by the FEDS framework (Venable et al. 2016). Since we demonstrate the first evaluation via expert interviews and preliminary results in Sect. 6.2.2, we present our artifact’s real-world instantiation and subsequent quantitative evaluation in the following. The instantiation took place via workshops conducted in German using a virtual video conferencing tool with recording functionality for subsequent transcription and qualitative analysis. In each workshop, two researchers guided the participants through the model application while one continuously wrote memos to record observations and essential insights. Table 7 shows the conducted workshops and cases with participants representing their respective organization.

Manufacturing company (W1): The first summative evaluation took place during a workshop with the BMW Group, a worldwide automotive manufacturer. This workshop aimed to discuss a long-term BP-x strategy and assess the current state of BP-x capabilities within a particular use case. As part of the workshop, the case company gathered information on a specific BP-x use case for discussion during the workshop. Since one of the critical efficiency gains for a manufacturing organization is through production optimization, they selected a use case in the manufacturing

Table 7 Workshops, participants, and cases

Workshop	Current position	Company name	Company size
W1	Strategy Project Lead	BMW Group	119,000
W2	Managing directors	Appollo Systems GmbH	10–50
W3	Consultant BPM, Business Analyst, BPM Specialist	LIDL	192,000

environment. In our workshop, we discussed the *engine assembly process*. The use case arose from the issue that current processes are opaque and the rework rate should be reduced. Thus, the goal was to automatically identify, document, and analyze processes with process mining to identify outliers. The company's long-term goal is to build prescriptive analytics capabilities to predict errors in production and prevent them with appropriate process interventions and adjustments.

Software development and consulting company (W2): The second real-world application of our model took place in a workshop with Appollo Systems GmbH. The case company is a low-code digitalization platform vendor that seamlessly integrates business analysis, design, implementation, and testing. The motivation behind applying the operationalized BP-x management model was the upcoming extension of their software product with the BP-x capability areas predictive and prescriptive process analytics. During our workshop, we addressed the *digital application process* as a use case already implemented for a customer that works in the financial sector, with the main business areas of credit and debt. More specifically, the company automatized, standardized, and digitalized the process to reduce cycling time and improve quality.

Retail company (W3): The third real-world case was LIDL, one of the leading companies in the food retail industry in Germany and in Europe more broadly. LIDL currently operates over 12,000 stores and over 200 logistics centers and warehouses in 31 countries. The motivation for participating in the workshop was the upcoming cross-organizational uptake of process mining for process analysis and identification in the company. Overall, the goal is to support standardization across various countries and improve the processes. In particular, the company expects to save time and costs, increase customer satisfaction, facilitate employees' work, and increase their satisfaction with descriptive process analytics.

Results of reusability evaluation: Finally, after applying our model in a real-world use case during the workshop, we asked all participants to assess the reusability of our proposed model according to Iivari et al. (2021). We complemented the evaluation with a quantitative analysis after the instantiation of our model to determine whether its application in a real organizational environment would require further modifications to the proposed model design. The participants completed an online questionnaire in which they rated accessibility, importance, novelty & insightfulness, actability & guidance, and effectiveness on a 5-Point Likert scale (1 = strongly disagree, 5 = strongly agree). This questionnaire was made available to each workshop participant separately and anonymously to prevent the participants

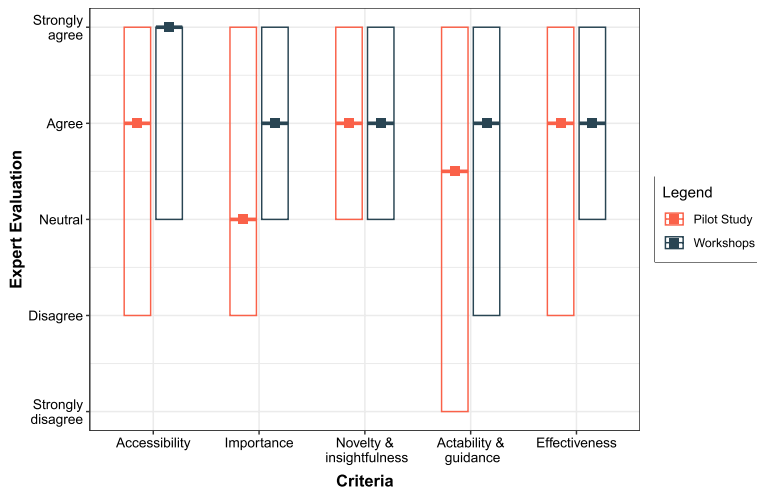


Fig. 4 Comparison of the pilot study and workshop reusability evaluation results according to Iivari et al. (2021)

from influencing one another and encourage candid feedback. In line with the questionnaire used in the pilot study, we asked multiple questions per evaluation criterion. Figure 4 depicts the corresponding results compared to the pilot study results.

The quantitative study of our model's reusability provides convincing evidence in favor of the improvement in model design during the second design cycle. The data indicate that each evaluation criterion has improved substantially compared to the pilot study results. In particular, the frequency of the response option in the upper range of Likert-type items shows an upward trend. Notably, Likert-type data is ordinal data, and we cannot use the mean as a measure of central tendency. Thus, we computed the median for each Likert-type item as an appropriate measure and displayed the distribution of responses (Fig. 4).

Beyond quantitative results, during the workshops, the participants affirmed the accessibility and importance of our model. All participants appreciated the model as guidance for effectively and efficiently managing BP-x initiatives.

9 Discussion

This study used qualitative techniques to analyze how the road map for fruitful BP-x initiatives leveraging novel technological capability areas in BPM can be shaped. Our findings fall into two broad categories: implications for theory and implications for practice. In the following, we present our findings derived from qualitative analysis of the semi-structured interviews and workshops.

9.1 Theoretical implications

IS, as an applied research discipline, seeks to solve practice-inspired design problems by developing and evaluating novel IT artifacts. DSR has traditionally merged the emphasis on the IT artifact with a significant focus on relevance in the application domain (Hevner et al. 2004). Consistent with Drechsler and Hevner (2018), we developed an IT meta-artifact covering nomothetic knowledge about technology to inspire the development of further artifacts that primarily contribute to prescriptive knowledge. Thus, our artifact is categorized in Mode 1B of design theorizing modes (Drechsler and Hevner 2018) by informing the realization of future solution entities.

In light of our research question, the thematic focus of our study is on managerial and organizational characteristics supporting data-driven work in organizations. We contribute to socio-technical theory (Bostrom and Heinen 1977) by investigating enablers, capabilities, and directives needed on the BP-x uptake journey. In this context, we explore the relation and mutual assistance between an organization's technical and social BP-x sub-systems. Our work culminates in constructing a technologically inclusive, holistic, extensible, data and process-driven "*next generation BPM*" model. With our developed model, we want to enable organizations to leverage and manage the technological possibilities within the BPM, process mining, process analytics, process automation, and other realms in future upcoming technologies. Furthermore, we seek to provide solution design knowledge that acknowledges and anticipates the inherent nature of change in the real world, technologies, organizations, and processes. In doing so, we lay the foundation for resilient organizations. Moreover, the socio-technical theory functions as a theoretical lens for analyzing and understanding organizational process change's social, technical, and environmental aspects. In our study, we observed the relationships between the model constructs data, enablers, and capabilities as technical sub-systems, which interrelate with the constructs incentive, initialization, action, and outcome as a social sub-system. Environmental or contextual factors influence both sub-systems. Our observations add to the research results by Schmiedel et al. (2020), who conducted an empirical study on BPM culture that demonstrates the importance of cultural requirements in technology-enabled initiatives.

In the future, new technologies will emerge and disrupt the way in which digital process management currently works. To proactively account for inherited change and technological innovation (Chia 1999; Tsoukas and Chia 2002), the findings of our study can serve as a basis for a BP-x research agenda and assist in deriving essential research topics. As technological frontiers evolve into organizational phenomena, human agency is permanently confronted with changing conditions that unfold as processes. With this in mind, research on the intersection between BP-x initiatives and various types of change, i.e., intentionality and degree of change (Röglinger et al. 2022), are highly relevant from a BPM perspective. We contribute to this research by integrating the methodological stages of *incentive* and *action* into our model to account for the mutually reinforcing relation between technological advancements and change. In addition, we partially address how organizations must organize themselves when change is constitutive of reality.

There are various methodologies for conducting data science projects in general and process mining projects in particular (Emamjome et al. 2019). As we demonstrated in Sects. 3 and 6.1, there is a lack of research that consolidates BP-x

technologies into the management mindset and includes the necessary organizational and managerial perspectives on an operationalized level. By investigating how realized synergies in BP-x initiatives lead to the continuous development of process and data-driven decision-making in organizations, we contribute to the IS success model (DeLone and McLean 1992). In this context, by identifying and describing enablers and capabilities, we lay the foundation for identifying critical organizational, managerial, and technological resources for measuring BP-x success. Future research could empirically investigate the relationship between technological advancements and culture, people, governance, and organizational structure that decrease the socio-technical barriers to value creation from data.

9.2 Practical implications

For practitioners, our model provides an actionable and prescriptive directive to outline the BP-x road map for organizations. Primarily, it can support them in allocating investments, technological resources, and capabilities to strengthen data-driven decision-making. To succeed on the BP-x adoption journey, our model assists in defining a BP-x strategy while being aware of the necessary organizational and technological capabilities. During the initialization and planning of BP-x initiatives, our model can function as a workshop template to reach a shared understanding with main stakeholders (W1,W2,W3), such as process owners, process participants, and process analysts. Thus, our model can function as a tool for scoping and initializing BP-x endeavors in a series of workshops to set goals and strategy by drawing on multiple stakeholders with different backgrounds from different departments. To promote the adoption and actual use of the BP-x management model, we have taken the initiative to publish our workshop template that served as a guide during the evaluation phase. We aim to make the BP-x management model more accessible and user-friendly for stakeholders seeking to implement it in their respective domains.⁷ Beyond providing guidance with the *operationalized BP-x management* model, we highlight certain specific recommendations for practitioners.

Practitioners need help creating a workable BP-x strategy and vision due to their inexperience and limited understanding of what BP-x can and cannot do (I7). A well-defined BP-x strategy is an essential starting point (I8,I16), but because some organizations need more expertise with BP-x technology, they must gather experience to develop a meaningful strategy. Therefore, practitioners must first “*start small and show the value of technology*” (I19). For example, organizations can minimize BP-x uptake barriers by first selecting and prioritizing a single business case and demonstrating the value of BP-x insights through a PoC or pilot project (I2,I3). Then, they can use pilot project results to clarify outcomes and define their value contribution. Subsequently, organizations can process operational insights to formulate a BP-x strategy that facilitates the communication of BP-x benefits and the influence on employees’ day-to-day work (I2,I9,I13).

⁷ Access the mural template through the link provided: <https://app.mural.co/template/0545ab43-8857-477b-b5e7-a45ff5e9c7fc/7d429b7e-84d2-4e99-beeb-8e4cd586623b>.

If an organization aims to make BP-x a long-term and continuous endeavor, the scope and goals will shift from the business case to the organizational level. BP-x Ops implies strengthening the connection between BP-x capabilities and strategic intent (I12,W1). As a result, the strategy of BP-x initiatives should be aligned with the goals, values, and beliefs of their organizations (I8). The explicit connection to strategic initiatives, such as digital transformation or sustainability, promotes visibility and shared understanding of the benefits of BP-x across stakeholders (I19).

At the same time, our findings suggest that practitioners should be aware of the impact of organizational size and structure on the starting point and progression of BP-x initiatives (I1,I3,I6,I8). First, the starting point of BP-x depends on the level of digitalization (I1,I3,W2). Second, the BP-x initiative can act as a digital transformation driver (I8,I19). Finally, non-tech industries and medium-sized organizations mainly focus on descriptive process analytics at the PoC level and disregard more mature BP-x capabilities such as predictive or prescriptive process analytics. In addition, prescriptive applications have yet to be supported by commercial tools. In this respect, organizations need a holistic picture of BP-x's capabilities and possibilities to generate a viable vision of opportunities. Here, our model comes into play and provides an actionable overview of how to establish BP-x systems from vision to implementation.

9.3 Limitations

The findings of this study should be weighed against possible limitations related to the nature of the qualitative analysis of interview and literature data as well as the artifact design considerations made. First, as with expert interview studies, the findings reflect the perception of a limited number of experts recruited from our network. Although we have attempted to include a heterogeneous group of participants and a sufficiently large sample to minimize bias, we cannot formally rule out the presence of bias. Nonetheless, the semi-structured interview guideline used in the interviews and the positive feedback observed throughout the studies strengthened our confidence in the validity of our findings.

Second, while the literature review results offered a valuable starting point for learning about the state-of-the-art in data-driven BPM, we cannot explicitly rule out bias due to the authors' interdisciplinary backgrounds. For example, this might have influenced the pre-selection of relevant papers. Nevertheless, we are confident in the validity of our findings since we followed the structured approach by vom Brocke et al. (2009), cross-checked the results, and defined inclusion and exclusion criteria to counteract bias.

Finally, the evaluation showed that our model guides organizations toward BP-x initiatives on a managerial level. Arguably, the execution and implementation of BP-x technologies pose technical challenges that are omitted from our model but that strongly impact how well BP-x is applied in reality. Despite these limitations, our findings demonstrate the advantages of combining adjacent research streams of BP-x technologies and BPM to provide a comprehensive scope of established knowledge in the research field. We call for further research that aligns BPM with technological advances to provide the guidance needed in times of change.

10 Conclusion

Managers rely on proven strategies, approaches, and tools to adapt to the new reality caused by technological advances. To date, the fragmentation of process and non-process technologies in academia and practice hinders the uptake and management of cutting-edge technologies in alignment with BPM. For systematization, we propose the *operationalized BP-x management* model as a conceptual IT meta-artifact of a two-cycled DSR project. Our model provides a holistic view of the enablers, capabilities, and procedures of BP-x initiatives and supports strategic directives for data-driven BPM approaches. Accordingly, we contribute to the general problem class of how organizations create value from data.

During the model design and development, qualitative analysis of literature and interview data informed our model design according to the grounded theory methodology. Thereby, detailed interpretations of implications and models from the academic literature were used to generate the composition of the model. Then, insights gained through interviewing practitioners and retrieving their real-world observations and experience drove the model construction. In conclusion, our model provides novel design knowledge grounded in literature and informed by practice to enable the systematic management of data-driven BPM in alignment with emerging technologies in organizations.

The theoretical implications in Sect. 9.1 highlight exciting possibilities for research. Additionally, this study provides new insights that can be valuable in future investigations. Firstly, advancing our model to a framework would enable conceptual guidance and support for practical implementation in a more detailed manner or might elucidate sector-specific or international differences. Secondly, future work could further operationalize the findings of our study through developing a maturity model to support organizations' self-assessment and benchmarking of BP-x maturity. Thirdly, a replication and extension of our study from the perspective of how organizations can prioritize capabilities regarding the outcome could be a future research avenue. This prioritization can be used to derive what steps organizations should take to encourage BP-x initiatives to create business value. Future research could empirically analyze the relationships among model constructs, specifically data, enablers, and capabilities as part of the technical subsystem and the connections among incentive, initialization, action, and outcome as components of the social subsystem. Finally, more research is needed to understand how organizations manage the relationship between technological change and people in organizations in the face of rapidly advancing BP-x research and practice.

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