Context-Aware Business Process Management Method Assessment and Selection

Abstract. Context awareness is essential for successful business process management (BPM). So far, research has covered relevant BPM context factors and context-aware process design, but little is known about how to assess and select BPM methods in a context-aware manner. As BPM methods are involved in all stages of the BPM lifecycle, it is key to apply appropriate methods to efficiently use organizational resources. Following the design science paradigm, the study at hand addresses this gap by developing and evaluating the Context-Aware BPM Method Assessment and Selection (CAMAS) Method. This method assists method engineers in assessing in which contexts their BPM methods can be applied and method users in selecting appropriate BPM methods for given contexts. The findings of this study call for more context awareness in BPM method design and for a stronger focus on explorative BPM. They also provide insights into the status quo of existing BPM methods.

Keywords: Business process management, BPM methods, Context-aware BPM, BPM lifecycle, Method selection, Design science research

1 Introduction

Business process management (BPM) is an important discipline driving corporate success (vom Brocke and Mendling 2018). Today, organizations must seize opportunities and overcome challenges related to new technologies, customer expectations, and competitors, which makes the ability to respond to situational requirements increasingly important (Edvardsson et al. 2018; Oc 2018). That means, for example, that BPM in start-ups should differ from large multi-national organizations or that creativity-intensive processes have different requirements than low-creativity processes (vom Brocke et al. 2016). To better identify and structure such situational requirements, research has analyzed the overall BPM context of organizations, e.g., the nature of processes or the fit between business environment and processes (Dumas et al. 2013; Melão and Pidd 2000; vom Brocke et al. 2016). Hence, scholars advocate that organizations must consider context when institutionalizing BPM (Harmon and Wolf 2018; Kerpedzhiev et al. 2020) and that a one-size-fits-all approach is likely to fail (vom Brocke et al. 2016). Moreover, context awareness has been recognized as an important principle of successful BPM (vom Brocke et al. 2014) and as a central theme covered by future BPM capabilities (Kerpedzhiev et al. 2020).

The notion of context is increasingly being covered in the BPM literature. Vom Brocke et al.'s (2016) BPM context framework, for example, considers the overall goal of BPM, the characteristics of business processes as well as organizational and environmental characteristics. Melão and Pidd's (2000) framework specifically focuses on the nature of processes, e.g., in terms of goals and activities. Moreover, defining process context in terms of time, location, legislation, culture, and performance requirements, Rosemann and Recker (2006) focus on context-aware process design. Other examples can be found in the area of context-aware process modeling (Ploesser and Recker 2011; Rosemann et al. 2008) and process mining (Günther et al. 2008). Nevertheless, prescriptive knowledge related to context-aware BPM is scarce (Denner et al. 2018b). This is especially true for BPM methods, i.e., tools and techniques that enable performing activities along the BPM lifecycle (Rosemann and vom Brocke 2015), which are key for successful BPM. In some cases, the use of general-purpose, i.e., context-independent, BPM methods such as Six Sigma or value-added analysis (Dumas et al. 2018) is sufficient. In other cases, however, the application of BPM methods that do not fit the context in which they are employed may cause an inefficient use of organizational resources (Dumas et al. 2018; Rosemann and vom Brocke 2015) or even the failure of BPM projects (Schmidt et al. 2001).

Although some researchers have already called for context-aware BPM methods (Kohlborn et al. 2014; Rosemann et al. 2008; van der Aalst 2013; vom Brocke et al. 2016), there has been little response so far, meaning that most BPM methods still assume a one-size-fits all approach (vom Brocke et al. 2016). Today, most BPM methods are not context-specific – or at least they do not state in which contexts they can or should be applied. Recent examples of BPM methods which account for specific contexts are Anastassiu et al. (2016), who proposed a method for identifying information that is most likely to influence the process goal, and Denner et al. (2018b), who developed a method for exploiting the digitalization potential of business processes. Despite these contributions, little is known about context-aware BPM methods (Rosemann et al. 2008; vom Brocke et al. 2016). Specifically, practitioners lack guidance on *assessing* the applicability of BPM methods currently being used and on *selecting* appropriate BPM methods for given contexts. Hence, they do not know whether their BPM methods are fit for purpose (Zelt et al. 2018). Against this background, our research question is as follows: *How can BPM methods be assessed and selected in a context-aware manner?*

To answer this question, we propose an artifact called the Context-Aware BPM Method Assessment and Selection (CAMAS) Method, following the design science research (DSR) paradigm (Gregor and Hevner 2013). The CAMAS Method consists of three components: a Classification Framework, a Selection Process, and an Assessment Process. It supports organizations in addressing two fundamental use cases. First, BPM method engineers (e.g., BPM researchers, consultants) or users (e.g., BPM researchers, process managers) can use the CAMAS Method to assess BPM methods regarding their applicability to specific contexts (use case 1). Second, BPM method users can use the CAMAS Method to select BPM methods that fit their contexts at hand (use case 2).

Our study is structured according to the DSR reference process as per Peffers et al. (2008). Having described the research problem in Section 1, we compile justificatory knowledge regarding BPM methods and context-aware BPM in Section 2. Section 3 outlines our research method and evaluation strategy, while Section 4 introduces the design specification of the CAMAS Method and Section 5 reports on its evaluation. We derive key findings, discuss theoretical and managerial implications, and address limitations and directions for future research in Section 6 and conclude in Section 7.

2 Theoretical Background

BPM is a principle-oriented and holistic management discipline, referring to the science and practice of improving and innovating business processes (Dumas et al. 2018; Schmiedel and vom Brocke 2015). Generally, BPM research can be structured according to two complementary perspectives: the *capability perspective* and the *lifecycle perspective* (Figure 1).

From the *capability perspective*, BPM is decomposed into capabilities relevant for implementing process orientation in organizations (de Bruin and Rosemann 2005). Many researchers have used this perspective to develop BPM capability frameworks (Kerpedzhiev et al. 2020; Niehaves et al. 2013; Rosemann and vom Brocke 2015). Rosemann and vom Brocke's (2015) seminal framework includes thirty capability areas grouped according to the so-called core elements of BPM: strategic alignment, governance, methods, information technology (IT), people, and culture. In this framework, the capability areas related to the core elements methods and IT are structured along the BPM lifecycle (Figure 1).

The *lifecycle perspective* considers stages along the lifetime of a process (Dumas et al. 2018). Research has offered several BPM lifecycle models (de Bruin and Rosemann 2005; Dumas et al. 2018; van der Aalst 2013), including that of Rosemann and vom Brocke (2015), which covers the following stages:

process design and modelling, implementation and execution, monitoring and control, improvement and innovation as well as project and program management.

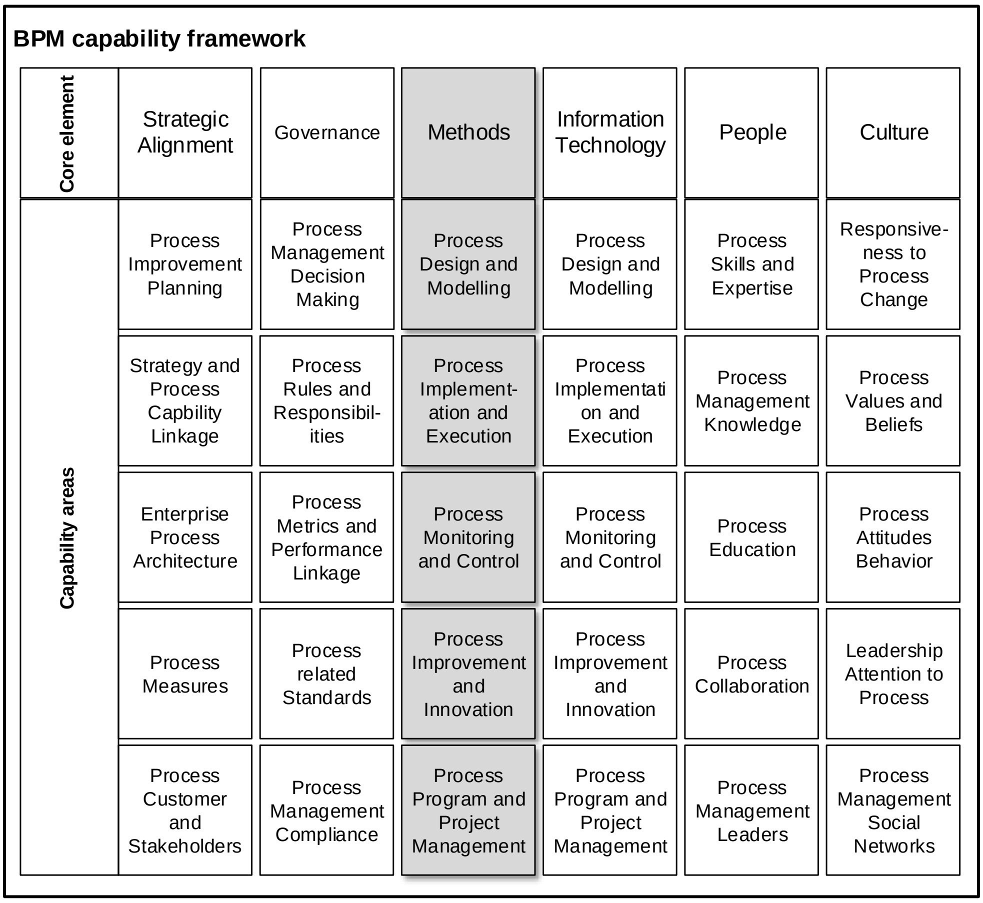

Figure 1: Integrated visualization of BPM capability areas and the BPM lifecycle

Generally, a *method* is a collection of problem-solving approaches and a specific way of thinking, consisting of directions and rules, structured in a systematic way (Avison 1996; Brinkkemper 1996). Following Braun et al. (2005), we refer to a method as an approach offering a systematic structure to perform work steps to achieve defined goals. Methods feature attributes and elements (Denner et al. 2018b; Vanwersch et al. 2016), which are summarized in Table 1. In BPM, methods are defined as sets of tools and techniques that support and enable consistent activities along the BPM lifecycle (Rosemann and vom Brocke 2015). For our purposes, we define a 'BPM method' as a method that can be used in at least one stage of the BPM lifecycle.

Table 1: Frequently mentioned method components

	Name	**Description**
Attributes	Goal orientation	Methods must strive for achieving specific goals
	Systematic approach	Methods must include a systematic procedure model
	Principles orientation	Methods must follow general design guidelines and strategies
	Repeatability	Methods must be repeatable in different contexts
Elements	Meta model	Model that specifies the conceptual data model of the results
	Activity	Task that creates a distinct (intermediate) output
	Technique	Detailed instruction that supports the execution of an activity
	Tool	Tool (e.g., software) that supports the execution of an activity
	Role	Actor that executes or is involved in the execution of an activity
	Defined output	Defined outcome per activity (e.g., documents)

When institutionalizing BPM or applying BPM methods, organizations must consider the context(s) in which they are operating (vom Brocke et al. 2014). Generally, context awareness evolved from contingency theory (Donaldson 2001), considering information that characterizes an entity's situation (Dey 2001). *Context-aware BPM*, which is often used as umbrella term covering related discussions in the literature, challenges organizations to consider their contexts and to respond to situational requirements in BPM activities (Harmon and Wolf 2018; Kerpedzhiev et al. 2020). To help organizations identify their context, researchers have analyzed the organizational context, the nature of processes as well as the fit between the business environment and business processes, and have proposed various frameworks (Dumas et al. 2013; Melão and Pidd 2000). One well-established example is vom Brocke et al.'s (2016) BPM context framework, which provides an overview of contextual dimensions, factors, and characteristics relevant for BPM (Figure 2). As there is – to the best of our knowledge – no other work that structures BPM context dimensions more comprehensively, we used this framework in the course of our research. For further details on the BPM context framework, please see vom Brocke et al. (2016).

Context factor	**Example characteristics**		
Goal dimension			
Focus	Exploitation		Exploration
Process dimension			
Value contribution	Core process	Management process	Support process
Repetitiveness	Repetitive		Non-repetitive
Knowledge - intensity	Low knowledge-intensity	Medium knowledge-intensity	High knowledge - intensity
Creativity	Low creativity	Medium creativity	High creativity
Interdependence	Low interdependence	Medium interdependence	High interdependence
Variability	Low variability	Medium variability	High variability
Organization dimension			
Scope	Intra-organizational processes		Inter-organizational processes
Industry	Process industry	Product industry	Product & service industry
Size	Start-up	Small and medium enterprise	Large organization
Culture	Culture supportive for BPM		Culture non-supportive for BPM
Resources	Low organizational resources	Medium organizational resources	High organizational resources
Environment dimension			
Competitiveness	Low competitive environment	Medium competitive environment	Highly competitive environment
Uncertainty	Low environmental uncertainty	Medium environmental uncertainty	High environmental uncertainty

Figure 2: BPM context framework (vom Brocke et al. 2016)

3 Research Design

Our study follows the DSR paradigm (Gregor and Hevner 2013) and adopts the DSR methodology by Peffers et al. (2008), with the CAMAS Method being our central artifact. An overview of our research process is shown in Figure 3. The first two phases have already been presented in Section 1.

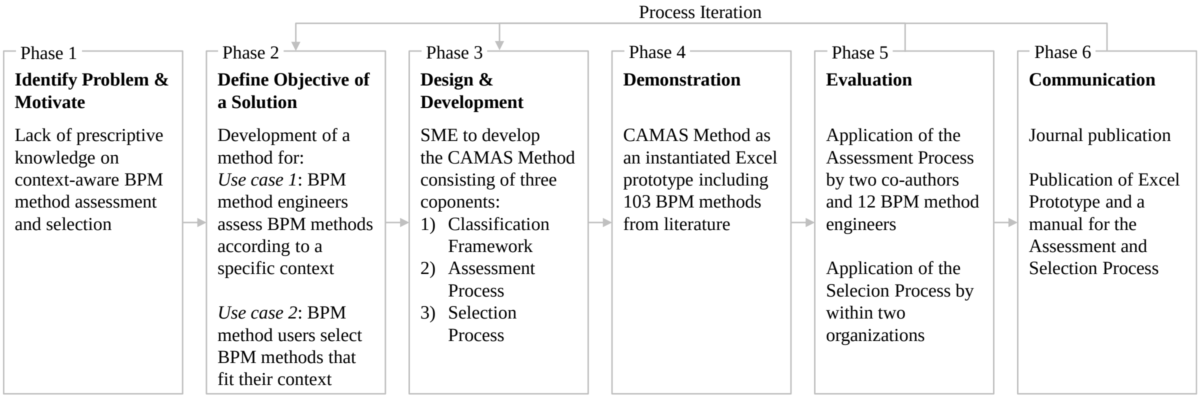

Figure 3: DSR methodology to propose our CAMAS Method

The CAMAS Method is specified in the *design and development* phase. As research method, we rely on situational method engineering (SME), which assists in the development of methods suitable for specific situations (Brinkkemper 1996; Henderson-Sellers and Ralyte 2010). In general, SME distinguishes between method configuration and method composition (Bucher et al. 2017). While method configuration refers to the adaptation of a generic method for specific situations, method composition compiles fragments from existing methods against situational needs (Ralyté et al. 2003). In line with the two use cases addressed by the CAMAS Method (Section 1), it consists of a Classification Framework that serves as a joint meta model for the Assessment and a Selection Process. The Classification Framework extends an existing assessment scheme (Denner et al. 2018a) and builds on the BPM lifecycle (Rosemann and vom Brocke 2015) as well as the BPM context framework (vom Brocke et al. 2016). When defining the Assessment and the Selection Process, we did not create an entirely new end-to-end method, but composed existing fragments against the background of context awareness in BPM. The Assessment Process uses classification techniques, whereas the Selection Process leverages techniques from multi-criteria decision analysis as justificatory knowledge. Hence, we follow the method composition mode and abided by related guidance from the literature. Moreover, the Assessment and the Selection Process account for the method components identified in Section 2 (Table 1). We report on details in Section 4.

To *demonstrate and evaluate* the CAMAS Method, we chose an evaluation strategy using well-known evaluation criteria for methods as artifacts, namely ease of use, real-world fidelity, effectiveness, and efficiency (March and Smith 1995; Sonnenberg and vom Brocke 2012). The overall objective was to determine whether the CAMAS Method contributes to the knowledge on context-aware BPM. Hence, the evaluation covered both the demonstration and evaluation of all components of the CAMAS Method (Pries-Heje et al. 2008; Sonnenberg and vom Brocke 2012; Venable et al. 2012). To that end, we prepared an Excel prototype with a sample of 103 BPM methods retrieved from the literature, which supports the execution of the Assessment and the Selection Process. Please find details and design decisions regarding the structured literature review (e.g., coverage, search term, timeframe, and selection criteria) in Appendix 1. To evaluate the Assessment Process and the Classification Framework, we applied it in two phases. First two co-authors – being researchers and BPM method engineers – independently assessed the identified BPM methods (including the CAMAS Method) and added them to the Excel prototype (use case 1). Second, to obtain first-hand classifications and get insights into the ease of use of the Assessment Process, we asked 20 original BPM method engineers to assess around 20% of the methods per lifecycle stage from our sample (30 in total). We received an assessment for 20 methods by 12 BPM method engineers. To evaluate the Selection Process, BPM method users from two organizations selected BPM methods for six real-world processes against individual context requirements (use case 2). We report on details and results of our evaluation activities in Section 5.

Finally, to *communicate* our results, we intend to publish the study in an information systems (IS) journal. Moreover, the Excel prototype for the Assessment and Selection Process including the 103 BPM methods is provided online.

4 Design Specification

4.1 Overview

The CAMAS Method consists of a Classification Framework, an Assessment Process, and a Selection Process. Linking the CAMAS Method to the method attributes from Table 1, it focuses on the context awareness of BPM methods (*goal orientation*). Therefore, the Classification Framework structures context along three dimensions that build on the BPM lifecycle and the BPM context framework introduced in Section 2 (*principle orientation*). Guidelines for the application of the Classification Framework are embedded in the Assessment and the Selection Process (*systematic approach*). The Assessment Process guides BPM method engineers and users to assess existing or newly developed BPM methods regarding their applicability to specific contexts (use case 1). Assessed BPM methods feed into the Method Base of the CAMAS Method, so the Assessment Process is an important prerequisite for the application of the Selection Process. The Selection Process, in turn, guides BPM method users to select BPM methods that fit their contexts at hand (use case 2). Both processes are further specified in terms of *activities*, which comprise *techniques*, *tools*, *roles*, and *outputs* that support their execution in various contexts and among various users (*repeatability*). Figure 4 illustrates the structure of the CAMAS Method and the relationship among its components. Details on each component are provided in Section 4.2 (Classification Framework), Section 4.3 (Assessment Process), and Section 4.4 (Selection Process).

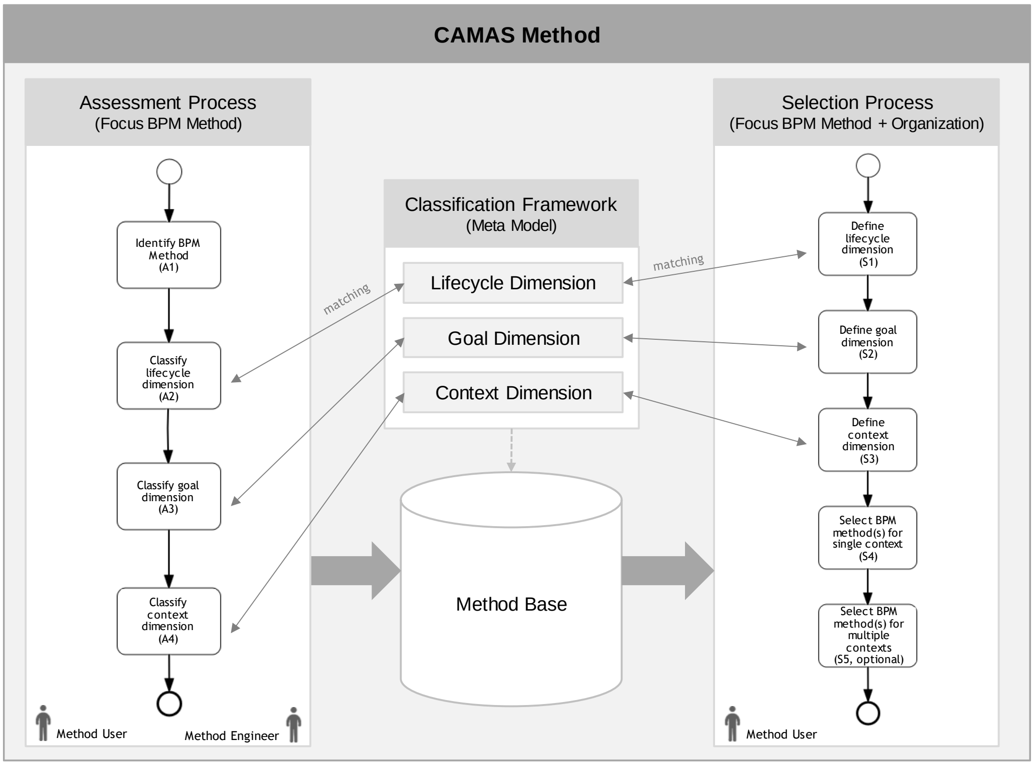

Figure 4: Overview of the CAMAS Method

4.2 Classification Framework

At the center of the CAMAS Method, the Classification Framework facilitates the assessment of BPM methods' applicability in terms of BPM lifecycle stages (*lifecycle dimension*), goal orientation (*goal dimension*), and various context dimensions of the BPM context framework (*context dimension*). The Classification Framework extends an existing assessment scheme (Denner et al. 2018a) and builds on the BPM lifecycle (Rosemann and vom Brocke 2015) as well as the BPM context framework (vom Brocke et al. 2016). Figure 5 illustrates the Classification Framework as a three-dimensional cuboid that serves as joint meta model for the Assessment and the Selection Process.

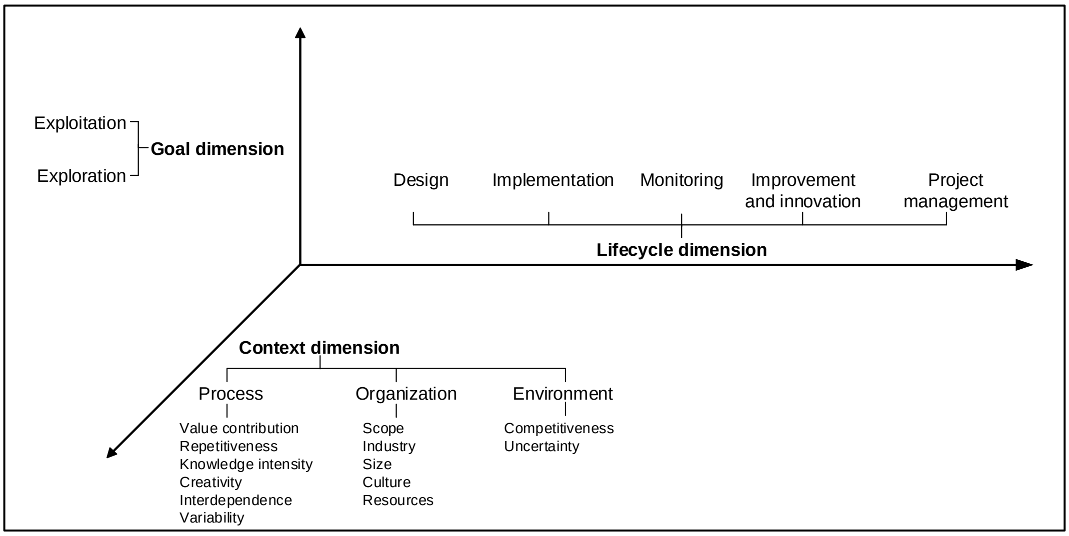

Figure 5: Overview of the Classification Framework

The *lifecycle dimension* represents the BPM lifecycle stages, so BPM methods can be categorized along five elements: process design and modelling, implementation and execution, monitoring and control, improvement and innovation, and project and program management (Rosemann and vom Brocke 2015). For reasons of simplicity, we shortened the names to design, implementation, monitoring, improvement and innovation, and project management.

The *goal dimension* refers to a BPM method's goal orientation, differentiating exploitation and exploration (Benner and Tushman 2003). In line with its strategy, an organization decides whether to exploit (i.e., improve), explore (i.e., innovate), or both (vom Brocke et al. 2016). The other dimensions of the BPM context framework refer to the given context and cannot be modified, so the Classification Framework separates the goal dimension from the process, organization, and environment dimensions.

The *context dimension* covers the last three dimensions of the BPM context framework, which consist of additional hierarchically structured context factors and characteristics. Unlike the BPM lifecycle and the goal dimension, most characteristics of the context dimension are not assessed in a yes-or-no but a high-or-low logic. In contrast to vom Brocke et al.'s (2016) BPM context framework, we assess each context factor on a two-point scale and avoid medium-level characteristics (e.g., medium knowledge intensity) to achieve a binary categorization of BPM methods. The medium-level characteristics of the context factors lack a clear definition, so they depend heavily on subjective interpretation that could bias assessment and selection results (Christenfeld 1995). As unified measures and thresholds for context characteristics yet need to be developed, we used generic definitions (vom Brocke et al. 2016).

4.3 Assessment Process

Linking the Assessment Process to the method attributes (Table 1), it strives for assessing the applicability of existing or newly developed BPM methods in specific contexts (*goal orientation*) and, using the Classification Framework, it integrates the lifecycle dimension and the BPM context dimension outlined in Section 2 (*principle orientation*). Comprised of four consecutive steps, the Assessment Process starts with determining which BPM method to assess. This method is then assessed in terms of the lifecycle dimension. Finally, the method is classified based on the characteristics of the goal dimension and other context dimensions (*systematic approach*). Completing each step (Table 2) supports the execution of the Assessment Process in various contexts and among various users (*repeatability*). We provide more detailed insights below. The evaluation of the Assessment Process is discussed in Section 5.1.

Table 2: Overview of the Assessment Process' elements

Activity	Technique	Tool	Role	Output
Identify BPM method (A1)	- Identify an existing or newly developed BPM method to be assessed. - Ensure suitability of BPM method to go through the Assessment Process.	- Literature review (e.g., Journals, Conferences, textbooks, consultancies) - BPM method definition (Section 2)	- BPM method engineer (e.g., BPM researcher, consultancies) - BPM method user (e.g., BPM researcher, process manager)	- Newly developed/identified BPM method suitable to go through the Assessment Process
Classify lifecycle dimension (A2)	- Classify the BPM method regarding the lifecycle dimension.	- Classification Framework (Excel prototype) - BPM lifecycle		- BPM method classified with respect to BPM lifecycle stage(s)
Classify goal dimension (A3)	- Classify the BPM method regarding the goal dimension.	- Classification Framework (Excel prototype) - BPM context framework		- BPM method classified with respect to goal characteristic(s)
Classify context dimension (A4)	- Classify the BPM method regarding the context dimensions. - Ensure validity and reliability of the assessment. - Assess context specificity of the BPM method.	- Classification Framework (Excel prototype) - Assessment criteria: (na), (a), (−) - Hit ratios, Cohen's Kappa - Indicator: Degree of context specificity (*DCS*)		- BPM method classified with respect to context characteristics - BPM method assessed as special- or general-purpose method - Extended Method Base

Identifying a BPM method (A1) requires determining an existing or newly developed BPM method whose applicability to a specific context should be assessed (*technique/output*). Therefore, a literature review can be helpful (*tool*). To ensure that the identified BPM method is suitable to go through the Assessment Process (*technique*) and, thus, to be an appropriate input for the Selection Process, it should match the definition of a BPM method (Section 2) (*tool*). Depending on the used technique, activity A1 is performed by a BPM method engineer who developed a new BPM method or by a BPM method user who comes across an unclassified BPM method in the course of their daily business (*role*).

Classifying the lifecycle dimension (A2) requires classifying the BPM method with respect to the targeted BPM lifecycle stage in line with the Classification Framework (*technique/output*). If a BPM method is applicable to more than one BPM lifecycle stage, a multiple assessment can be performed. This activity is supported by the proposed Excel prototype (*tool*). For a better understanding on how the Excel prototype works, please find a blank version online. Activity A2 is performed by a BPM method engineer for a newly developed BPM method or a BPM method user for an existing BPM method (*role*).

Classifying the goal dimension (A3) requires classifying the BPM method with respect to its characteristic(s) in the goal dimension (*output*), that is, to assess whether the BPM method is geared to incremental improvement (exploitation), radical (re-)design (exploration), or both (Rosemann 2014) (*technique*). This activity is supported by the proposed Excel prototype (*tool*). Again, activity A3 is performed by a BPM method engineer or BPM method user (*role*).

Classifying the context dimension (A4) requires using the process, organization, and environment dimensions of the BPM context framework to classify the BPM method according to the Classification Framework (*output*). The BPM method user determines whether the BPM method is applicable to the underlying characteristics (*technique*). The applicability of a BPM method to a specific context is expressed by a nominal scale that consists of three assessment criteria: not applicable (na), applicable (a), and not assessable (−) (*tool*). The last criterion serves as an auxiliary value for external assessors who do not know the original BPM method engineer's intention. In summary, the assessment criteria have the following semantics:

- (na): the BPM method is **n**ot **a**pplicable to a specific context characteristic.
- (a): the BPM method **a**pplies to a specific context characteristic.
- (−): the method's applicability to a specific context characteristic cannot be assessed.

If the Assessment Process is not performed by the original BPM method engineer, we recommend ensuring the assessment's reliability by involving at least two independent judges (*technique*). Therefore, the Excel prototype calculates Cohen's Kappa (Cohen 1960) per BPM method (Appendix 2) (*tool*). Besides ensuring the reliability of the assessment, we recommend analyzing the assessed BPM methods with respect to their degree of context specificity (*DCS*), i.e., an indicator to classify whether the BPM method follows a special or a general purpose (*technique*). This addresses the need for selecting suitable BPM methods that support the efficient use of organizational resources. As no suitable indicator for measuring the *DCS* is available in the literature, we developed the formula shown in Eq. (1) (*tool*). An exemplary calculation can be found in Appendix 2.

$$DCS = \left(1 - \left(\frac{\sum_{f \in F} \frac{\alpha_f}{|C_f|}}{|F|}\right)\right) \cdot \left(1 - \frac{\gamma}{\sum_{f \in F} |C_f|}\right) \qquad \text{(Eq. 1)}$$

with

F	Set of context factors included in the context dimension of the Classification Framework
C_f	Set of characteristics per context factor $f \in F$
α_f	Number of characteristics assessed with (a) for context factor $f \in F$
γ	Number of characteristics assessed with (−) across all context factors F

According to Eq. (1), the *DCS* represents a weighted fraction of the characteristics per context factor in which a specific BPM method can be applied. To make the *DCS* comparable across different BPM methods in the case that some characteristics cannot be assessed, the second factor of Eq. (1) adjusts the weighted fraction based on the number of characteristics assessed with (−). Hence, in the absence of characteristics that cannot be assessed, a *DCS* of 100% means that a BPM method is applicable to only one characteristic per context factor (i.e., special-purpose method), while a *DCS* of 0% means that a BPM method applies to all characteristics of all context factors (i.e., general-purpose method). Again, activity A4 is performed by a BPM method engineer or method user (*role*).

4.4 Selection Process

Linking the Selection Process to the method attributes (Table 1), it assists BPM method users to select BPM methods applicable to their organizational contexts (*goal orientation*) and, just like the Assessment Process, relies on the Classification Framework (*principle orientation*). Comprised of four necessary and one optional step, the Selection Process starts with defining the BPM lifecycle stage to which BPM methods should be applicable. Then, the method's overall target is determined. After that, the characteristics of the other context dimensions to which BPM methods should be applicable are defined. The last task is to identify and select the BPM method(s) that performs best across all dimensions. An additional optional step accounts for the fact that several contexts need to be considered in a single organization (Kerpedzhiev et al. 2020), so the query of the Method Base can vary depending on the method user's specific role. For example, a BPM process owner or manager may be searching for BPM methods for a specific process in a defined BPM lifecycle stage, while a Head of BPM or a process portfolio manager may take a multi-context perspective, aiming to identify BPM methods that meets as many contextual needs as possible. As the Selection Process refers to only one context, it must be applied repeatedly in that case (*systematic approach*). The detailed description of each step (Table 3) supports the execution of the Selection Process in various contexts and among various users (*repeatability*). Again, we provide deeper insights below. An evaluation of the Selection Process is given in Section 5.2.

Table 3: Overview of the elements of the Selection Process

Activity	Technique	Tool	Role	Output
Define lifecycle dimension (S1)	- Define to which BPM lifecycle stage BPM methods should be applicable.	- Classification Framework (Excel prototype) - Method Base	- BPM method user (e.g., BPM researcher, process manager)	- Defined BPM lifecycle stage
Define goal dimension (S2)	- Define the characteristic(s) of the goal dimension to which BPM methods should be applicable.	- Classification Framework (Excel prototype) - Method Base		- Defined goal characteristic(s)
Define context dimension (S3)	- Define the characteristics of the context dimension to which BPM methods should be applicable. - Determine the relative importance of all factors and dimensions.	- Classification Framework (Excel prototype) - Method Base - Multi-criteria decision analysis		- Defined (weighted) characteristics of the context dimension
Select BPM method(s) for single context (S4)	- Identify BPM method(s) that fit given context.	- Classification Framework (Excel prototype) - Method Base - Indicator: degree of applicability (*DA*) including risk-averse and risk-taking calculation modus, degree of context specificity (*DCS*), additional optional criteria.		- BPM method(s) that take a single-context perspective
Select BPM method(s) for multiple contexts (S5, optional)	- Perform activities S1-3 repeatedly. - Identify BPM method(s) that fit various contexts.	- Classification Framework (Excel prototype) - Method Base		- BPM method(s) that take a multi-context perspective

Defining the lifecycle dimension (S1) involves defining the BPM lifecycle stage to which BPM methods should be applicable according to the Classification Framework (*technique*). This activity is supported by the Excel prototype (*tool*). Just like for the Assessment Process, the Excel prototype including a preliminary Method Base of 103 BPM methods can be found online. Activity S1 is usually performed by a process owner or manager (*role*). All subsequent activities consider only those methods that fit the defined BPM lifecycle stage (*output*).

Defining the goal dimension (S2) requires defining to which characteristic(s) of the goal dimension BPM methods should be applicable (*technique*). As in the previous activity, one filters the characteristics of exploitation and/or exploration within the goal dimension (vom Brocke et al. 2016) in line with the Classification Framework (*tool*). As this decision may be relevant to the organization's strategy, activity S2 is probably not only performed by a process owner or manager, but also supported by the Head of BPM or similar roles (*role*). All subsequent activities consider only those BPM methods that fit the defined characteristic(s) of the goal dimension (*output*).

Defining the context dimension (S3) requires defining to which of the context dimension's characteristics BPM methods should be applicable (i.e., considering all characteristics of the process, organization, and environment dimensions) (*technique*). BPM method users must go through all characteristics and decide which characteristics represent their organizational contexts. As all characteristics are mutually exclusive, one characteristic per context factor, at most, can be chosen (e.g., scope: intra-organizational processes *or* inter-organizational processes). In the Excel prototype, the characteristics to which BPM methods should be applicable are assessed with the value of "1", all others with "0". If a method should be applicable to more than one characteristic, the Selection Process must be applied repeatedly. Afterwards, the characteristics can be prioritized by determining relative weights. As the weighting happens on two hierarchy levels (i.e., context factors and dimensions), we draw from knowledge on multi-criteria decision analysis, such as the Analytical Hierarchy Process (Saaty 1990). To reduce complexity, the Excel prototype proposes an initial configuration, assuming that all characteristics are equally important, but the configuration can be changed as required (*tool*). Since this activity is related to the organization's strategy, it should be performed by several stakeholders, such as a process owner, process manager, or Head of BPM (*role*). If many stakeholders are involved, they may use techniques like brainstorming, moderated group discussion, and team estimation games to determine appropriate ratings (Schwaber 1997; Yoo et al. 2009). All subsequent activities consider only those BPM methods that fit the defined BPM lifecycle stage (activity S1) as well as the goal dimension's (activity S2) and context dimension's defined characteristics (*output*).

Selecting BPM method(s) for a single context (S4) requires analyzing all previous results and identifying the most suitable BPM method(s) (*technique*). Therefore, we recommend analyzing the degree of applicability (*DA*) of each BPM method for the context at hand. Again, as no suitable indicator is available in the literature, we developed the measure shown in Eq. (2), which reflects the extent to which a given BPM method is applicable to the context specified in the Selection Process (i.e., how often the criteria (a) or (na) match the specified context), considering that context dimensions and factors can differ in importance. In case a BPM method has not been assessed by the original method engineer, we offer two calculation modes. In the risk-averse mode, all (−) are treated as (na), i.e., context characteristics which could not be assessed based on publicly available data are treated as if the method were not applicable. In the risk-taking mode, however, all (−) are treated as (a). To prepare the calculation of the *DA*, all (a) and (na) values are replaced by 1 and 0, respectively. The *DA* of a given BPM method for a specified context is calculated as shown in Eq. (2). An illustrative example is included in Appendix 2.

$$DA = \sum_{d \in D} \sum_{f \in F_d} \sum_{c \in C_f} \omega_d \cdot \varphi_f \cdot \delta_c \cdot \varepsilon_c \qquad \text{(Eq. 2)}$$

with

D	Set of dimensions included in the context dimension of the Classification Framework
F_d	Set of context factors per context dimension $d \in D$
C_f	Set of characteristics per context factor $f \in F$
ω_d	Weight of context dimension $d \in D$ with $\omega_d \in [0;1]$ and $\sum_{d \in D} \omega_d = 1$
φ_f	Weight of context factor $f \in F_d$ with $\varphi_f \in [0;1]$ and $\sum_{f \in F_d} \varphi_f = 1$
δ_c	Assessed context characteristic $c \in C_f$ of given BPM method with $\delta \in \{0,1\}$
ε_c	Assessed context characteristic $c \in C_f$ of given context with $\varepsilon \in \{0,1\}$

According to Eq. (2), a *DA* value of 100% means that a BPM method perfectly fits the specified context, while 0% means that a BPM method is not applicable at all. The *DA* is meant to be the main evaluation criterion for selecting suitable BPM methods, as it increases inter-subjectivity when comparing methods based on a consistent calculation logic. Depending on the *DA*, all remaining BPM methods are ranked so users can shortlist the BPM methods that will be subject to a detailed assessment. To support this narrowing-down, the *DCS* indicator, which we introduced in Activity A4, should also be considered to assess whether a BPM method follows a special or a general purpose. Details on comparing BPM methods based on their *DCS* and *DA* values are provided in Section 5.2. If desired and necessary, organizations can also integrate further criteria like the methods' ease of use, training effort (Recker et al. 2009), or required upfront investments (Neubauer and Stummer 2007) (*tool*). Depending on how the BPM method will be applied, we recommend involving all relevant stakeholders in the shortlisting process (*role*). The result is the identification of BPM method(s) that meet the given context needs, thus taking a single-context perspective (*output*).

Selecting BPM method(s) for multiple contexts (S5, optional) instructs the user of the Selection Process to perform activities S1, S2, and S3 repeatedly if there are several contexts in one organization to be considered. Unlike activity S4, activity S5 requires comparing multiple results and selecting the BPM method(s) that fit various contexts, not just one context (*technique*). The *DA* and *DCS* of multiple iterations are compared using a cross-context validation. If each iteration yields similar BPM methods in its shortlist, it is not necessary to implement various methods to account for all contexts. If each iteration yields different shortlisted methods, it might be necessary to implement multiple BPM methods. As outlined in activity S4, the *DA* and *DCS* are automatically calculated by the Excel prototype to support the selection decision (*tool*). Activity S5 is performed by roles such as Head of BPM or process portfolio manager (*role*). The result is the identification of BPM method(s) that meet as many of the context's needs as possible, thus taking a cross-context perspective (*output*).

5 Artifact Evaluation

5.1 Evaluation of the Assessment Process

To evaluate the Assessment Process and the Classification Framework, we applied the Assessment Process in two phases. In the first phase, we applied it to a sample of 103 BPM methods (102 BPM methods from the literature and the CAMAS Method) to gain preliminary insights into its ease of use, real-world fidelity, effectiveness, and efficiency. Two co-authors independently assessed each BPM method. This setup is sensible as a two-assessor setting is commonly used in the literature (Montazemi and Qahri-Saremi 2015; Paré et al. 2015; Wolfswinkel et al. 2013) and as the co-authors are both academic BPM method engineers and users, developing new BPM methods and using BPM methods in projects. As organizations typically do not have access to the original engineers of the BPM methods included in the Method Base, we deliberately decided not to involve them in the first evaluation phase.

Following the Assessment Process, activity A1 revealed that all 103 identified BPM methods are suitable for being assessed, as they comprise all method components and apply to at least one BPM lifecycle stage (Table 1, Section 2). However, as most BPM methods do not explicitly state each component, the authors discussed their fit based on indications and decided on their suitability for being assessed. Conducting activity A2 to A4 revealed that especially activity A4 was challenging, leading to discrepancies in assessing the applicability of BPM methods. As almost no BPM method explicitly stated its applicability to specific contexts, the assessment is mainly based on indications, which leave room for interpretation and differing assessments. Thus, we only used the criteria (a) and (na) if, in the respective research paper, a method explicitly stated or clearly indicated its applicability to a specific context characteristic. Otherwise, we used the auxiliary criterion (−). In case of disagreement, the authors discussed all mismatches and decided on a single criterion for the final assessment. To account for discrepancies and ensure the reliability of the classification as performed by the co-authors, we calculated Cohen's Kappa (Cohen 1960). The Kappa ranged from 61% to 100% with an average of 77%, which indicates substantial agreement (Landis and Koch 1977). All assessment results are presented in Appendix 3. Figure 6 shows two methods per BPM lifecycle stage and goal characteristics assessed along A2 to A4.

In the second phase, we asked original BPM method engineers to assess selected BPM methods based on the Assessment Process. We asked 20 BPM method engineers to cover around 20% of BPM methods per lifecycle stage from our sample (30 in total). All BPM method engineers received a questionnaire (Appendix 4) including questions related to activity 2 to 4 of the Assessment Process. Additionally, the method engineers were asked to comment on and assess the ease of use of the Assessment Process using a 7-point scale. Overall, we received first-hand classifications from 12 BPM method engineers who assessed 20 BPM methods. To get insights into the validity of the assessment performed by the co-authors, we compared their classification with that performed by the original BPM method engineers and calculated hit ratios (Moore and Benbasat 1991), which measure the frequency of correctly assigned objects (Nahm et al. 2002). In case we used the auxiliary criterion (−), we assumed a match of both assessments, and in case of a different assessment using (a) and (na), we assumed a mismatch. The co-authors achieved hit ratios between 90% and 100%, yielding an average of 97%, which reflects significant agreement (Moore and Benbasat 1991). All assessment results are presented in Appendix 5.

The application of the Assessment Process 226 times with co-authors and original BPM method engineers showed its *effectiveness* and *efficiency* to assess BPM methods in a context-aware manner (use case 1). Even though slight discrepancies between the co-authors occurred when conducting activity A4, a circumstance that would also happen in industry settings, the achieved Cohen's Kappa values confirm reliability. Moreover, the hit ratios between the co-authors and the original BPM method engineers underpin the validity of the Assessment Process. This also led us to conclude that the Method Base with 103 exemplary BPM methods was a solid basis for evaluating the Selection Process (Section 5.2). As for *real-world fidelity*, the evaluation showed that the assessed methods cover diverse contexts in which BPM methods are applied. Regarding *ease of use*, the original BPM method engineers assessed the ease of use with 5 out of 7 points. Even though the co-authors stated that the classification of some methods was challenging, it is reasonably easy for BPM method engineers. Most original BPM method engineers confirmed the detailed description of each activity, corresponding techniques, tools as well as definitions per dimension, context factor, and characteristic as sufficient to assess BPM methods. Nevertheless, some of them asked for extended guidelines in the sense of a manual, which we plan to provide when publicly sharing the CAMAS Method after publication. Overall, the evaluation confirmed that the Assessment Process is appropriate to assess BPM methods in a context-aware manner.

				Context dimension (see Activity A4)																														
				Process dimension													Organization dimension												Environment dimension				Indicator	Reliability
				Value contribution			Repetitive-ness		Knowledge intensity		Creativity		Inter-dependence		Variability		Scope		Industry			Size			Culture		Resources		Competitive-ness		Uncertainty			
ID	Author	Lifecycle dimension (see Activity A2)	Goal dimension (see Activity A3)	Core process	Management process	Support process	Repetitive	Non-repetitive	Low knowledge-intensity	High knowledge-intensity	Low creativity	High creativity	Low interdependence	High interdependence	Low variability	High variablity	Intra-organizational processes	Inter-organizational processes	Product industry	Service industry	Product & service industry	Start-up	Small and medium enterprise	Large organization	Culture highly supportive of BPM	Culture non-supportive of BPM	Low organizational resources	High organizational resources	Low competetive environment	High competetive environment	Low environmental uncertainty	High environmental uncertainty	Degree of context specificity (DCS)	Cohen`s Kappa
3	Anastassiu et al. 2016	Design	Exploitation	a	–	–	a	–	-	–	–	–	–	a	–	a	a	–	–	–	–	–	–	–	a	–	–	–	–	–	–	a	21%	67%
30	Fdhila et al. 2015	Implementation	Exploitation	a	–	a	–	–	–	–	–	–	–	–	–	–	na	a	–	–	–	a	–	–	–	–	–	–	–	–	–	–	15%	77%
43	Johannsen and Fill 2014	Implementation	Exploitation	–	–	–	–	–	na	a	na	a	–	–	na	a	na	a	–	–	–	–	–	–	a	–	–	a	–	–	–	–	27%	76%
1	Abe and Kudo 2014	Monitoring	Exploitation	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	a	–	–	a	–	–	–	–	6%	78%
2	Accorsi et al. 2015	Monitoring	Exploitation	–	–	–	–	–	–	a	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3%	65%
4	Antunes et al. 2014	Improvement and innovation	Exploitation	–	–	–	a	–	–	–	–	–	–	a	–	–	a	–	–	–	–	–	–	–	a	na	–	a	–	–	–	–	17%	67%
9	Bergener et al. 2015	Improvement and innovation	Exploitation	–	–	–	a	na	–	–	–	–	–	–	a	na	a	na	–	–	–	na	–	a	a	na	na	a	–	a	–	a	34%	82%
103	CAMAS Method	Project management	Exploitation	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	0%	100%
19	de Boer et al. 2015	Project management	Exploitation	–	a	–	–	–	–	–	–	–	–	–	–	–	a	na	–	–	–	na	–	a	a	na	–	–	–	–	–	–	21%	71%
84	Ruiz et al. 2015	Design	Exploration	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	a	–	–	–	–	a	–	a	9%	100%
57	Lindman et al. 2016	Implementation	Exploration	a	na	na	–	–	–	–	–	–	–	–	–	–	a	–	–	–	–	–	–	–	–	–	–	–	na	a	na	a	24%	76%
95	Trkman et al. 2015	Implementation	Exploration	a	na	na	–	–	–	–	–	–	–	–	–	–	na	a	–	–	a	–	–	–	a	–	–	–	–	a	–	–	23%	85%
5	Appel et al. 2014	Design	Exploration & exploitation	–	–	–	a	–	–	–	–	–	–	–	a	na	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	10%	79%

a applicable to a specific context characteristic   na not applicable to a specific context characteristic   – applicability is not assessable

Figure 6: Exemplary exploitative and explorative BPM methods related to all stages of the BPM lifecycle

5.2 Evaluation of the Selection Process

Two BPM method users from two different organizations applied the Selection Process to gain insights into its ease of use, real-world fidelity, effectiveness, and efficiency. We chose experts from two organizations that differ widely in terms of their organizational setup. In both organizations, we interviewed the key expert responsible for BPM (Table 4) using qualitative semi-structured interviews (Myers and Newman 2007) along the activities of the Selection Process, also using the Excel prototype. Each interview took about two hours and was attended by two co-authors. After introducing the Selection Process, we asked the experts to select three real processes from their organizations, to apply each of the Selection Process' activities. Besides, we asked for comments on ease of use, real-world fidelity, effectiveness, and efficiency. To obtain results, we pre-filled the Method Base with the 103 BPM methods we had assessed during the evaluation of the Assessment Process (Section 5.1). An overview of the two organizations, their experts, and the processes in focus is presented in Table 4.

Table 4: Organizations, experts, and processes involved in the evaluation

Organization & Industry	Employees	Annual revenue	Current position	Work experience	Processes (evaluation objectives)
SERVICE - Software	130,000 (2017)	EUR 100 billion (2017)	Program Director	> 15 years	(P1) Define and document architecture (P2) Establish product group advisory (P3) Export control classification
PRODUCT - Cosmetics	3,000 (2017)	EUR 0.3 billion (2017)	Head of Process and Change Management	> 10 years	(P4) Develop a new product (P5) Control performance indicators (P6) Purchase raw materials

We present as an example the results of the evaluation related to the product development process (P4) at the PRODUCT organization (Table 4), while the results of all other processes are shown in Appendix 6. As P4 has already been designed, implemented, and improved at PRODUCT, the expert searched for a method with which to "monitor" the process (S1). Moreover, PRODUCT requested an exploitative BPM method (S2). Regarding the context characteristics, all relevant characteristics were marked. The context factors and dimensions were also weighted. PRODUCT was more interested in considering the process (0.6) and the organization dimension (0.4) than the environment dimension (*S3*). Finally, the results were analyzed (*S4*). The results of activities S1 to S4 are presented in Figure 7.

To compare the most suitable BPM methods for the given context, all BPM methods are ranked according to the indicator *DA*, i.e., the extent to which they are applicable to the specified context. PRODUCT calculated the *DA* based on the risk-averse mode. The results show that the *DA* of BPM methods assessed by the original BPM method engineers tend to be higher than that of methods assessed by the co-authors. This is because, in the risk-averse mode, all (−) are treated as (na) as no statement about the applicability of a BPM method to a specific context can be made based on publicly available data. Importantly, the Selection Process does not aim at estimating the *DA* as precisely as possible, but to compare BPM methods based on a consistent calculation logic. Hence, method users applying the Selection Process decide which calculation mode (i.e., risk-averse or risk-taking) they prefer. In concert with PRODUCT's expert, we analyzed a shortlist of seven methods that reached a *DA* above 48%, a mix of BPM methods assessed by BPM method engineers and the co-authors. To ensure a detailed analysis, the *DCS* indicator was considered as well, which ranged between 6% and 24%, indicating general-purpose methods. Accordingly, these BPM methods can be considered sufficient for the context at hand. The expert also stated that no other criteria (e.g., training effort) are necessary to identify a suitable BPM method. Based on the results of applying the Selection Process, PRODUCT examined the top seven methods in detail and selected one of them.

Both experts considered the Selection Process to provide valuable support and to have *benefits* for their daily work. They emphasized the relevance of our research as most organizations face the challenge to select suitable BPM methods. However, the experts pointed to challenges regarding its application, which has been incorporated in the Selection Process. An overview of the experts' feedback and how it was incorporated is included in Appendix 6. Below, we present a summary of the results.

As for *effectiveness* and *efficiency*, the experts confirmed that the Selection Process is a well-founded, yet pragmatic, way to reason about how to select BPM methods in a context-aware manner (use case 2). It reduces time and uncertainty in selecting suitable BPM methods and, thus, facilitates an efficient use of resources for their implementation. The experts acknowledged that the Method Base includes not only well-known BPM methods, but also unknown BPM methods that inspire to consider context from various perspectives and support the exploration goal of BPM. As for *real-world fidelity*, the experts confirmed that the Selection Process is suitable for various contexts as the multi-dimensional architecture of the Classification Framework allows for a comprehensive analysis. As for *ease of use*, the experts confirmed that the activities of the Selection Process are understandable for people typically involved in BPM. The experts particularly appreciated the detailed description of each activity, corresponding tools (e.g., Excel prototype), and definitions of each dimension, context factor, and characteristic (vom Brocke et al. 2016). Even though the determination of the relative importance of factors and dimensions (S3), the analysis of *DA* and *DCS* (S3), and the cross-context validation of various BPM methods (S5) was challenging, the experts appreciated the possibility to prioritize specific contexts and analyze the results in detail. Additionally, the experts emphasized the need of activity S5 as due to scarce resources and training effort for new BPM methods, it is indispensable to select BPM methods that fit various contexts. To overcome these challenges, techniques like brainstorming, moderated group discussion, and team estimation games (Schwaber 1997; Yoo et al. 2009) are appreciated. Nevertheless, the experts also saw *room for improvement* in the visualization of the Excel prototype, e.g., by directly providing access to definitions of all dimensions and descriptions of all BPM methods. We outline respective ideas for future research in Section 6.3.

				Context dimension (see Activity S3)																																
				0,6													0,4												0,0						
				Process dimension													Organization dimension												Environment dimension				Indicator (see Activity S4)		
				0,2			0,2		0,0		0,0		0,4		0,2		0,25		0,25			0,0			0,25		0,25		0,6		0,4				
				Value contribution			Repetitive-ness		Knowledge intensity		Creativity		Inter-dependence		Variability		Scope		Industry			Size			Culture		Resources		Competitive-ness		Uncertainty				
				Core process	Management process	Support process	Repetitive	Non-repetitive	Low knowledge-intensity	High knowledge-intensity	Low creativity	High creativity	Low interdependence	High interdependence	Low variability	High variability	Intra-organizational processes	Inter-organizational processes	Product industry	Service industry	Product & service industry	Start-up	Small and medium enterprise	Large organization	Culture highly supportive of BPM	Culture non-supportive of BPM	Low organizational resources	High organizational resources	Low competetive environment	High competetive environment	Low environmental uncertainty	High environmental uncertainty	**Degree of applicability (DA)**	**Rank (DA)**	**Degree of context specificity (DCS)**
ID	**Author**	**Lifecycle dimension (see Activity S1)**	**Goal dimension (see Activity S2)**	1	0	0	1	0	0	1	1	0	0	1	0	1	0	1	0	0	1	0	1	0	0	1	0	1	1	0	1	0			
15	Breuker et al. 2016*	Monitoring	Exploitation	1	0	1	1	0	1	0	1	0	1	1	1	1	1	1	1	1	1	0	1	1	1	0	1	1	1	1	1	0	90%	1,5	24%
98	van der Aa et al. 2018*	Monitoring	Exploitation	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	0	1	1	1	1	1	1	1	1	1	1	90%	1,5	6%
8	Bala et al. 2017*	Monitoring	Exploitation	1	1	1	0	1	0	1	0	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	78%	3	15%
16	Cabanillas et al. 2014*	Monitoring	Exploitation	1	1	1	1	0	1	1	1	0	1	0	1	1	1	0	1	1	1	1	1	1	1	0	0	1	1	1	1	0	56%	4	27%
11	Bolsinger et al. 2015*	Monitoring	Exploitation	1	0	1	1	0	1	1	1	0	1	0	1	0	1	0	1	1	1	0	1	1	1	1	1	1	1	1	1	0	54%	5	28%
18	Cuzzocrea et al. 2018	Monitoring	Exploitation	0	0	0	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	48%	6,5	14%
63	Maaradji et al. 2015	Monitoring	Exploitation	0	0	0	1	0	0	1	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	48%	6,5	19%
13	Borkowski et al. 2017	Monitoring	Exploitation	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	34%	8,5	15%
35	Graupner et al. 2015	Monitoring	Exploitation	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	34%	8,5	20%

* BPM method assessed by original BPM method engineer

Figure 7: Results of applying the Selection Process to PRODUCT’s process of developing a new product (P4) (risk-averse mode)

6 Discussion

6.1 Analysis of Existing BPM methods

The literature review (Appendix 1) we used to evaluate the Classification Framework and the Assessment Process also provided general insights into the applicability of the identified 103 BPM methods to specific contexts. We structured these insights along the *lifecycle*, *goal*, and *context dimension* (Figure 10). First, when analyzing the 103 BPM methods per *lifecycle stage* (Figure 8A), we found that BPM methods for implementation (*n*=10), improvement and innovation (*n*=16), and project management (*n*=12) are rare compared to other BPM lifecycle stages. These findings confirm prior investigations, indicating that these stages still need more attention from BPM researchers (Recker and Mendling 2016). Second, regarding the *goal dimension* (Figure 8B), we found that 102 BPM methods only apply to exploitation, while two BPM methods are for exploration only and seven fit both exploitation and exploration. Also these findings comply with prior studies, indicating the lack of explorative BPM methods (Gross et al. 2019; Kohlborn et al. 2014). Third, regarding the *context dimension*, we investigated the *DCS* (Figure 8C). The *DCS* ranges between 0% and 45% with an average of 16% indicating that most methods included in our sample rather follow a general-purpose approach. This finding supports our research problem and calls for further research (Section 6.3).

[A] 103 BPM methods classified by BPM lifecycle stages*

BPM lifecycle stages	**Total numbers**
Design	44
Implementation	10
Monitoring	35
Improvement and innovation	16
Project management	12

[B] 103 BPM methods classified by goal characteristic(s)*

Goal characteristics	**Total numbers**
Exploitation	102
Exploration	2
Exploitation and exploration	7

[C] *DCS* based on BPM methods classified by context characteristic(s)

Degree of context specificity (*DCS*)
0% –45%; Ø 16%

* some BPM methods are classified to more than one BPM lifecycle stage and goal

Figure 8: Analysis of three dimensions of the Classification

6.2 Theoretical and Managerial Implications

Existing research offers limited insights into the question *how BPM methods can be assessed and selected in a context-aware manner*. In particular, research on the application possibilities of BPM methods and their design for specific contexts is missing (Dumas et al. 2018; Rosemann and vom Brocke 2015; vom Brocke et al. 2016). At the same time, guidance on how to assess and select BPM methods in a context-aware manner is missing (Zelt et al. 2018). The CAMAS Method proposed in this research is the first to conceptualize and operationalize the context-aware assessment and selection of BPM methods, so it contributes to both theory and practice.

We distinguish two *theoretical implications* that add to the descriptive and prescriptive knowledge on context-aware BPM. Regarding *descriptive knowledge*, our study extends the assessment scheme by

Denner et al. (2018a) in two different ways: first, the Classification Framework included in the CAMAS Method draws from the original assessment scheme and extends the context perspective (vom Brocke et al. 2016) through the lifecycle perspective (Rosemann and vom Brocke 2015). With the combination of both perspectives, we expect a more precise assessment of existing or newly developed BPM methods. Thereby, the Classification Framework's modular design enables high flexibility. As existing context dimensions can be dropped or new ones added easily, we account for future developments of context-aware BPM. Second, we extended the number of BPM methods in the Method Base from 25 (Denner et al. 2018a) to 103 by applying the Assessment Process (Section 5.1). Analyzing the status quo of this sample as a byproduct of our evaluation, we revealed various insights into existing BPM methods. Regarding the lifecycle perspective, we found that BPM methods for implementation, improvement and innovation, and project management are rare compared to the other lifecycle stages. As for the goal dimension, we identified a lack of explorative BPM methods. While existing research introduces ambidextrous BPM only on a high-level abstraction, we identified a few specific BPM methods recognizing and confirming the importance of distinguishing exploitative and explorative BPM methods. Finally, investigating the context perspective revealed an overall lack of context-specific BPM methods. So far, BPM method engineers have not explicated specific application contexts for most existing methods. These insights serve as a starting point for further discussions that will strengthen research on context-specific BPM methods (Section 6.3).

Regarding *prescriptive knowledge*, our study used SME to build an ensemble artifact (i.e., the CAMAS Method), which not only includes the Classification Framework but also offers guidance on its application in terms of a newly developed Assessment and Selection Process. In the end, the CAMAS Method helps compare BPM methods based on a common set of context-related dimensions and characteristics. The Assessment and Selection Process provide guidance on how to assess BPM methods regarding their applicability to specific contexts (use case 1) and on how to select BPM methods that fit their contexts at hand (use case 2). As the CAMAS method is not an entirely new end-to-end method but composes existing fragments against the background of context awareness in BPM, it accounts for the DSR contribution type 'exaptation', extending known solutions to new problems (Gregor & Hevner 2013).

Further, our work has several *managerial implications*. First, our study supports BPM method engineers as it facilitates the targeted application of their methods, which may increase adoption in practice. Second, our study guides practitioners in assessing the applicability of existing BPM methods to specific contexts. As the CAMAS Method helps understand the nature of BPM methods in a structured and well-founded manner, practitioners may challenge the applicability of BPM methods currently used in their organizations. Third, our study guides practitioners in selecting suitable BPM methods for specific contexts, reducing risks related to an inefficient use of resources or, in some cases, the failure of BPM projects (Section 1). The Method Base comprising 103 BPM methods can also inspire organizations to use new, perhaps locally unknown BPM methods. Finally, our study helps practitioners handle multiple contexts at the same time by applying the Selection Process repeatedly, comparing results, and selecting those BPM methods that fit various contexts. Overall, our findings reduce the uncertainty related to the selection of BPM methods and increase the transparency of related decisions.

6.3 Limitations and Future Research

Our research comes with *limitations* related to the design of the CAMAS Method and its evaluation. We present these limitations together with ideas for future research and make a call for action based on our findings. Finally, we point to research opportunities in related domains.

One limitation has to do with the *assumptions* we made for the CAMAS Method (Section 4) to reduce complexity. First, we assessed each context factor on a two-point scale, dropping medium-level characteristics (e.g., medium knowledge intensity). Future research may include more fine-granular specifications of the context characteristics, allowing for a more detailed assessment of BPM methods' applicability. Second, we propose two indicators, i.e., the *DA* and *DCS,* to support the selection of suitable BPM methods. Future research may investigate additional indicators to enhance BPM method selection.

The *evaluation of the CAMAS Method* also has limitations (Section 5). First, two co-authors independently assessed a sample of 103 BPM methods and 12 BPM method engineers were involved in obtaining first-hand classifications of 20 BPM methods. Future research may involve all original method engineers in the assessment of existing methods. Second, the evaluation builds on a structured literature review of articles in recognized journals and conferences in the BPM and IS discipline. However, we consciously decided not to include BPM methods from (text)books and/or consulting companies. This design decision had two reasons. On the one hand, we did not aim for a complete sample of BPM methods, as the identified methods primarily served the purpose of evaluating the Assessment Process and as a basis for applying the Selection Process. This purpose has been confirmed by applying the Assessment Process 226 times and the Selection Process six times with two organizations for real processes. On the other hand, we cannot rigorously decide which (text)books or consulting methods should be included, as many consulting methods are not publicly available. Thus, we started with those BPM methods that have been published in well-known and high-ranked journals and conferences in the field of IS and BPM. To address both limitations mentioned above and to facilitate a first-hand classification by BPM method engineers, we provide the current Method Base and the Excel prototype for the Assessment and Selection Process online. That way, many people can contribute to extending our compilation of existing BPM methods. Third, we evaluated the Selection Process in two organizations to gain preliminary insights. Future research should involve additional organizations from various contexts. Finally, future research may also further develop the prototype in terms of visualization and analysis functionality. For example, to automatize activity S5, a decision model could be proposed and implemented which automates the compilation, valuation, and selection of alternative combinations of BPM method(s) considering multiple contexts. To facilitate the real-world application of the Selection Process and developments of the prototype, we publicly shared the respective Excel prototype.

Beyond addressing limitations and future research, we make a *call for action*. Our key findings related to the status quo of BPM methods disposes us to call for more context awareness in BPM method design. In particular, we request that BPM method engineers assess the applicability of their methods to specific contexts when the method is being designed. We also call for the development of context-specific BPM methods that, for example, address frequent combinations of context characteristics. Additionally, an extension of explorative BPM methods is required, as they become more important in today's dynamic business environments (Grisold et al. 2019) and as most extant BPM methods are exploitative in nature. In doing so, BPM method engineers may consider methods from other disciplines (e.g., innovation management, design thinking, product engineering) to derive explorative methods applicable for BPM purposes. Besides developing new context-specific BPM methods, we call for broadening the knowledge on context-aware BPM with respect to additional context dimensions (e.g., customer dimension), supplementing the proposed dimensions of the BPM lifecycle and the BPM context framework or by expanding our approach to other core elements of BPM (e.g., governance, culture, or strategic alignment).

7 Conclusion

Given the increasing importance of context-aware BPM and the lack of related prescriptive knowledge, our research investigated how BPM methods can be assessed and selected while taking context into consideration. In line with the DSR paradigm, the CAMAS Method was developed by using SME as research method. It assists BPM method engineers and users in assessing the applicability of newly developed or existing BPM methods to specific contexts (use case 1) as well as BPM method users in selecting BPM methods that fit their contexts (use case 2). Drawing from justificatory knowledge on BPM in general and context-aware BPM in particular, the CAMAS Method consists of three components: a Classification Framework, an Assessment Process, and a Selection Process. We evaluated the CAMAS Method by building an Excel prototype, by assessing 103 BPM methods identified in a structured literature review, and by letting two organizations apply the method to six real-world processes. Our work contributes to the descriptive and prescriptive knowledge on context-aware BPM and helps practitioners select suitable BPM methods in order to efficiently use organizational resources.

References

Abe M, Kudo M (2014) Business Monitoring Framework for Process Discovery with Real-Life Logs. In: Sadiq S, Soffer P, Völzer H (eds) Proceedings of the 12th International Conference on Business Process Management, pp 416–423

Accorsi R, Lehmann A, Lohmann N (2015) Information Leak Detection in Business Process Models: Theory, Application, and Tool Support. Information Systems 47:244–257

Anastassiu M, Santoro FM, Recker J, Rosemann M (2016) The Quest for Organizational Flexibility. Business Process Management Journal 22:763–790

Antunes AS, Rupino da Cunha P, Barata J (2014) MUVE IT: Reduce the Friction in Business Processes. Business Process Management Journal 20:571–597

Appel S, Kleber P, Frischbier S, Freudenreich T, Buchmann A (2014) Modeling and Execution of Event Stream Processing in Business Processes. Information Systems 46:140–156

Avison DE (1996) Information Systems Development Methodologies: A Broader Perspective. In: Brinkkemper S, Lyytinen K, Welke RJ (eds) Method Engineering: Principles of Method Construction and Tool Support. Springer, Boston, MA, USA, pp 263–277

Benner MJ, Tushman ML (2003) Exploitation, Exploration, and Process Management: The Productivity Dilemma Revisited. Academy of Management Review 28:238–256

Bergener P, Delfmann P, Weiss B, Winkelmann A (2015) Detecting Potential Weaknesses in Business Processes. Business Process Management Journal 21:25–54

Braun C, Wortmann F, Hafner M, Winter R (2005) Method Construction: A Core Approach to Organizational Engineering. In: Haddad HM (ed) Proceedings of the 2005 ACM Symposium on Applied Computing, pp 1295–1299

Brinkkemper S (1996) Method Engineering: Engineering of Information Systems Development Methods and Tools. Information and Software Technology 38:275–280

Bucher T, Klesse M, Kurpjuweit S, Winter R (2017) Situational Method Engineering: On the Differention of "Context" and "Project Type". In: Ralyté J, Brinkkemper S, Henderson-Sellers B (eds) Situational Method Engineering: Fundamentals and Experiences, pp 33–48

Christenfeld DJG (1995) Choices from Identical Options. Psychological Science 6:50–55

Cohen J (1960) A Coefficient of Agreement for Nominal Scales. Educational and Psychological Measurement 20:37–46

de Boer FG, Müller CJ, Schwengber ten Caten C (2015) Assessment Model for Organizational Business Process Maturity with a Focus on BPM Governance Practices. Business Process Management Journal 21:908–927

de Bruin T, Rosemann M (2005) Towards a Business Process Management Maturity Model. In: Bartmann D, Rajola F, Kallinikos J, Avison DE, Winter R, Ein-Dor P, Becker J, Bodendorf F, Weinhardt C (eds) Proceedings of the 13th European Conference on Information Systems, pp 642–653

Denner M-S, Röglinger M, Schmiedel T, Stelzl K, Wehking C (2018a) How Context-Aware Are Extant BPM Methods? - Development of an Assessment Scheme. In: Weske M, Montali M, Weber I, Vom Brocke J (eds) Business Process Management, vol 11080, pp 480–495

Denner M-S, Püschel L, Röglinger M (2018b) How to Exploit the Digitalization Potential of Business Processes. Business & Information Systems Engineering 60:1–19

Dey AK (2001) Understanding and Using Context. Personal and Ubiquitous Computing 5:4–7

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

Dumas M, La Rosa M, Mendling J, Reijers HA (2013) Fundamentals of Business Process Management. Springer, Berlin

Dumas M, La Rosa M, Mendling J, Reijers HA (2018) Fundamentals of Business Process Management, 2nd ed. Springer, Berlin

Edvardsson B, Frow P, Jaakkola E, Keiningham TL, Koskela-Huotari K, Mele C, Tombs A (2018) Examining How Context Change Foster ServiceI innovation. Journal of Service Management 29:932–955

Fdhila W, Indiono C, Rinderle-Ma S, Reichert M (2015) Dealing with Change in Process Choreographies: Design and Implementation of Propagation Algorithms. Information Systems 49:1–24

Gregor S, Hevner AR (2013) Positioning and Representing Design Science Research for Maximum Impact. MIS Quarterly 37:337–355

Grisold T, Gross S, Röglinger M, Stelzl K, vom Brocke J (2019) Exploring Explorative BPM - Setting the Ground for Future Research. In: Hildebrandt T, van Dongen B, Röglinger M, Mendling J (eds) Business process management: 17th International Conference on BPM 2019, Vienna, Austria, September 1–6, 2019, vol 11675. Springer, Cham, Switzerland, pp 23–31

Gross S, Malinova Mandelburger M, Mendling J (2019) Navigating Through the Maze of Business Process Change Methods. In: Proceedings of the 52nd Hawaii International Conference on System Sciences, pp 6270–6279

Harmon P, Wolf C (2018) The State of Business Process Management 2018. A BPTrends Report

Henderson-Sellers B, Ralyte J (2010) Situational Method Engineering: State-of-the-Art Review. Journal of Universal Computer Science 16:424–478

Johannsen F, Leist S, Tausch R (2014) Wand and Weber's Good Decomposition Conditions for BPMN. Business Process Management Journal 20:693–729

Kerpedzhiev G, König U, Röglinger M, Rosemann M (2020) An Exploration into Future Business Process Management Capabilities in View of Digitalization: Results from A Delphi Study. Business & Information Systems Engineering

Kohlborn T, Mueller O, Poeppelbuss J, Röglinger M (2014) Interview with Michael Rosemann on Ambidextrous Business Process Management. Business Process Management Journal 20:634–638

Landis JR, Koch GG (1977) The Measurement of Observer Agreement for Categorical Data. Biometrics 33:159–174

Lindman M, Pennanen K, Rothenstein J, Scozzi B, Vincze Z (2016) The Value Space: How Firms Facilitate Value Creation. Business Process Management Journal 22:736–762

March ST, Smith GF (1995) Design and Natural Science Research on Information Technology. Decision Support Systems 15:251–266

Melão N, Pidd M (2000) A Conceptual Framework for Understanding Business Processes and Business Process Modelling. Information Systems Journal 10:105–129

Montazemi AR, Qahri-Saremi H (2015) Factors Affecting Adoption of Online Banking: A Meta-Analytic Structural Equation Modeling Study. Information & Management 52:210–226

Moore GC, Benbasat I (1991) Development of an Instrument to Measure the Perceptions of Adopting an Information Technology Innovation. Information Systems Research 2:192–222

Myers MD, Newman M (2007) The qualitative interview in IS research: Examining the craft. Information and Organization 17:2–26

Nahm AY, Rao SS, Solis-Galvan LE, Ragu-Nathan TS (2002) The Q-Sort Method: Assessing Reliability and Construct Validity of Questionnaire Items at a Pre-Testing Stage. Journal of Modern Applied Statistical Methods 1:114–125

Neubauer T, Stummer C (2007) Extending Business Process Management to Determine Efficient IT Investments. In: Wainwright RL, Haddad HM, Shin SY (eds) Proceedings of the 22nd ACM Symposium on Applied Computing, pp 1250–1256

Niehaves B, Poeppelbuss J, Plattfaut R, Becker J (2013) BPM Capability Development - A Matter of Contingencies. Business Process Management Journal 20:90–106

Oc B (2018) Contextual Leadership: A Systematic Review of How Contextual Factors Shape Leadership and Its Outcomes. The Leadership Quarterly 29:218–235

Paré G, Trudel MC, Jaana M, Kitsiou S (2015) Synthesizing Information Systems Knowledge: A Typology of Literature Reviews. Information & Management 52:183–199

Peffers K, Tuunanen T, Rothenberger MA, Chatterjee S (2008) A Design Science Research Methodology for Information Systems Research. Journal of Management Information Systems 24:45–77

Ralyté J, Deneckère R, Rolland C (2003) Towards A Generic model for Situtaional Method Engineering. In: Eder J, Missikoff M (eds) Advanced Information Systems Engineering. Springer, Berlin, pp 95–110

Recker J, Mendling J (2016) The State of the Art of Business Process Management Research as Published in the BPM Conference. Business & Information Systems Engineering 58:55–72

Recker J, Zur Muehlen M, Siau K, Erickson J, Indulska M (2009) Measuring Method Complexity: UML versus BPMN. In: Kendall KE, Varshney U (eds) Proceedings of the 15th Americas Conference on Information Systems, pp 1–9

Rosemann M (2014) Proposals for BPM Research Directions. In: Jung J-Y, Ouyang C (eds) Proceedings of the 2nd Asia Pacific Conference on Business Process Management, pp 1–15

Rosemann M, vom Brocke J (2015) The Six Core Elements of Business Process Management. In: vom Brocke J, Rosemann M (eds) Handbook on Business Process Management 1. Springer, Berlin, pp 107–126

Rosemann M, Recker J, Flender C (2008) Contextualisation of Business Processes. International Journal of Business Process Integration and Management 3:47–60

Ruiz M, Costal D, España S, Franch X, Pastor Ó (2015) GoBIS: An Integrated Framework to Analyse the Goal and Business Process Perspectives in Information Systems. Information Systems 53:330–345

Saaty TL (1990) How to Make a Decision: The Analytic Hierarchy Process. European Journal of Operational Research 48:9–26

Schmidt R, Lyytinen K, Keil M, Cule P (2001) Identifying software project risks: An international delphi study. Journal of Management Information Systems 17:5–36
Schmiedel T, vom Brocke J (2015) Business Process Management: Potentials and Challenges of Driving Innovation. In: vom Brocke J, Schmiedel T (eds) BPM - Driving Innovation in a Digital World. Springer, Cham, Switzerland, pp 3–15
Schwaber K (1997) SCRUM Development Process. In: Sutherland J, Casanave C, Miller J, Patel P, Hollowell G (eds) Proceedings of the 1995 Conference on Business Object Design and Implementation, pp 117–134
Sonnenberg C, vom Brocke J (2012) Evaluations in the Science of the Artificial–Reconsidering the Build-Evaluate Pattern in Design Science Research. In: Peffers K, Rothenberger MA, Kuechler B (eds) Proceedings of the 7th International Conference on Design Science Research in Information Systems, pp 381–397
Trkman P, Mertens W, Viaene S, Gemmel P (2015) From Business Process Management to Customer Process Management. Business Process Management Journal 21:250–266
van der Aalst WMP (2013) Business Process Management: A Comprehensive Survey. ISRN Software Engineering:1–37
Vanwersch RJB, Shahzad K, Vanderfeesten I, Vanhaecht K, Grefen P, Pintelon L, Mendling J, van Merode GG, Reijers HA (2016) A Critical Evaluation and Framework of Business Process Improvement Methods. Business & Information Systems Engineering 58:43–53
vom Brocke J, Mendling J (2018) Framework for Business Process Management: A Taxonomy for Business Process Management Cases. In: vom Brocke J, Mendling J (eds) Business Process Management Cases: Digital Innovation and Business Transformation in Practice. Springer, Cham, Switzerland, pp 1–26
vom Brocke J, Schmiedel T, Recker J, Trkman P, Mertens W, Viaene S (2014) Ten Principles of Good Business Process Management. Business Process Management Journal 20:530–548
vom Brocke J, Zelt S, Schmiedel T (2016) On the Role of Context in Business Process Management. International Journal of Information Management 36:486–495
Wolfswinkel JF, Furtmueller E, Wilderom CPM (2013) Using grounded theory as a method for rigorously reviewing literature. European journal of information systems 22:45–55
Yoo S, Harman M, Tonella P, Susi A (2009) Clustering Test Cases to Achieve Effective and Scalable Prioritisation Incorporating Expert Knowledge. In: Proceedings of the 18th International Symposium on Software Testing and Analysis, pp 201–211
Zelt S, Recker J, Schmiedel T, vom Brocke J (2018) A Theory of Contingent Business Process Management. Business Process Management Journal