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MANAGING THE LONG TAIL OF BUSINESS PROCESSES

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Research paper

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Abstract

Business Process Management (BPM) initiatives are typically centrally managed and follow a top-down design based on management commitment. Although that procedure is highly effective when managing a few structured processes at a time, emerging process-oriented organizations have shown increased demand for supporting, maintaining, and optimizing all of their processes comprehensively. Due to the scarcity of organizational resources, enterprises prioritize processes based on their strategic importance, dysfunctionality, and feasibility to be redesigned. Thus, a few highly relevant processes are improved, while a considerable amount of lower prioritized processes, which would still add value to the enterprise, are deferred. Furthermore, because the amount of low-value processes exceeds the amount of centrally managed processes, central BPM initiatives leave a large untouched potential for process optimization. In this paper, we conceptualize that phenomenon as the long tail of business processes. As a theoretical foundation, we formalize the management of long-tail process distributions as an optimization problem. We further introduce a novel methodology that integrates approaches from collaborative production models and concepts of centrally managed BPM initiatives to facilitate a holistic management of business processes.

Keywords: Business Process Management, Long Tail, Collaborative Process Management, Collaborative Production Models

1 Introduction

Business Process Management (BPM) constitutes a body of methods, techniques, tools, and systems to identify, prioritize, analyze, improve, and monitor business processes (Dumas et al. 2013; Weske 2012). Performed as central initiatives, BPM traditionally follows a top-down design based on management commitment and the downward integration of functional managers, process owners, and operational staff (ABPMP 2013; Dumas et al. 2013). Consequently, current BPM approaches characteristically entail a central collection and consolidation of necessary information and its distribution to all affected parts of the organization (Becker et al. 2013). This procedure has proven to be highly effective for identifying an enterprise's process architecture, as well as for managing a few explicit processes at a time that involve controlled interactions among participants and generate an immediate impact on an enterprise's value creation (Dumas et al. 2013).

As the scope of a centralized BPM initiative in a process-oriented enterprise is limited due to the scarcity of organizational resources (Dumas et al. 2013), more processes are documented than can be managed by a top-down approach. Consequently, processes for redesign and optimization are prioritized and selected based on their strategic importance, their health or dysfunction, and/ or their feasibility to be adapted (Davenport 1993).

Although established process classification frameworks, such as the American Productivity & Quality Center Process Framework (APQC 2016), comprise more than 50 high-level processes, enterprises generally cannot address more than a handful of those at a time (Dumas et al. 2013). As a result, current BPM initiatives typically manage a few high-value processes, while many other processes will most likely not be identified as suitable candidates, despite their, in sum, considerable improvement potential. Consequently, we argue that there is a large amount of processes which still bears untouched potential for improvement but is rarely optimized. To capture the benefits from these processes, new approaches to BPM are necessary to further improve an organization as central BPM initiatives generate too much overhead and improvement becomes unfeasible as a result.

In this paper, we conceptualize that phenomenon as the *long tail of business processes*. In the most part for economic reasons and thus due to operational constraints, organizations apply current methods of BPM only to processes that show a positive proportion of expected surpluses to the costs incurred by the BPM initiative, shaping a *line of manageability* where both values break even. Figure 1 illustrates the surplus in value of those processes to the left of the line of manageability and the long tail of processes to the right of it.

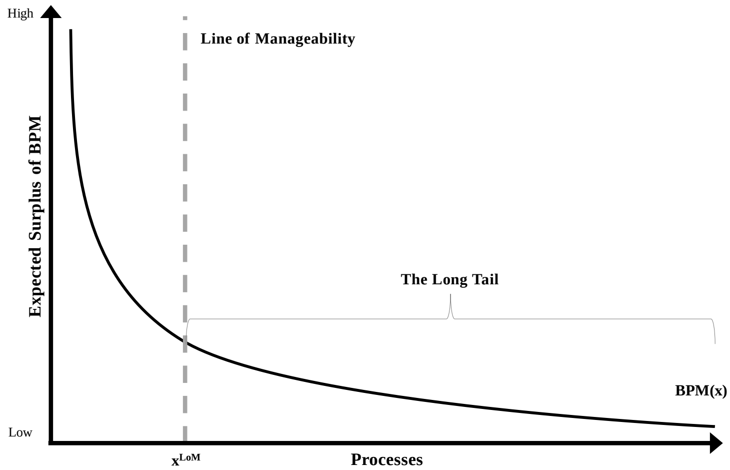

Figure 1. The Long Tail of Business Processes.

To access the long tail of business processes beyond the line of manageability and to include the bulk of low-value processes into a holistic approach, novel methods and techniques are necessary. They need to both reduce the costs incurred by BPM and improve the expected surplus so that organizations can feasibly engage with optimization activities in these processes. Thus, we have drawn upon implications from economic theory regarding the long tail of distributions and theory on collaborative production models to justify and develop a BPM method reducing optimization costs of low-value processes so that managing all processes becomes feasible. We summarize our research questions as follows:

(1) *How can we conceptualize and define the long tail of business processes?*
(2) *How do we need to modify activities in the BPM lifecycle to account for the specific requirements of all processes within a long tail process distribution?*

The paper is organized as follows: in Section 2, we explicate the applied research methodology to design and evaluate our artifact. In Section 3, we provide a brief overview of methods and techniques of BPM, as well as introduce relevant justificatory knowledge on the long tail and collaborative production models. The fourth section presents our conceptualization of the long tail in BPM, and in Section 5, we derive a set of practical guidelines for business practice. Finally, in Section 6, we summarize the paper's findings and provide an overview of limitations and future research potentials.

2 Research Methodology

To answer our research questions, we have used a design science research (DSR) procedure to develop our contribution. Following the knowledge contribution framework of Gregor and Hevner (2013), we consider our DSR contribution an exaptation of long tail theory for the design of collaborative production models in the area of BPM. It has explanatory power and provides design practice theory for the design and improvement of further methods, aiming to optimize BPM in a process-oriented enterprise. DSR typically comprises six iterative steps, including problem identification, the definition of objectives, design and development, demonstration, evaluation, and communication (Peffers et al. 2007).

We aim to address the problem of managing an organization's business processes holistically. Results from a qualitative study and a systematic literature review suggest not only a lack of BPM-related theoretical background knowledge, but also that available approaches focus on either central or decentral BPM activities, but do not provide an integrated concept to address a process organization comprehensively. Thus, we seek to define a theoretical framework that formalizes BPM decision-making and to derive practical guidelines for business practice. During the design and development phase, we draw upon the long tail theory and adapt it to the domain of BPM. Accordingly, we formalize our theorizations by introducing a mathematical model to reduce the complexity of BPM decision-making into an organizational utility maximization problem. Demonstrating the model's applicability, we present a graphical analysis to examine the effects of parameter variations and then construct guidelines to widen the scope of current BPM strategies. We evaluate our artifact by conducting interviews with domain experts and practitioners. Finally, we validate our model by providing formal mathematical proof and perform a sensitivity analysis to account for different sources of uncertainty in its inputs.

3 Justificatory Knowledge

To initiate the design of our main artifact, we introduce necessary foundations on BPM, collaborative production models, and the long tail theory in the subsequent section.

3.1 Business Process Management

According to Dumas et al. (2013), identifying, modeling, improving, executing, monitoring, and modifying business processes are among the most important activities of BPM. Thus, corresponding tasks are established parts of various BPM lifecycle models, which typically incorporate a set of sequentially ordered, iterative steps, following a plan-do-check-act-cycle (Hammer 2010). Due to the scarcity of resources, BPM initiatives implicitly focus on processes that directly or indirectly contribute to accomplishing an enterprise's strategy (Becker et al. 2013; Dumas et al. 2013). In process architectures, these processes are described as *core processes*, *support processes*, and *management processes* (Dumas et al. 2013; Lévy 1997; Porter 1998). To support decision-making in process discovery, Davenport (1993) and Dumas et al. (2013) suggest an initial prioritization of processes regarding their *importance*, *dysfunctionality*, and *feasibility*. Thus, a centrally managed BPM focuses on processes with a considerable impact on achieving a business's goals, that are dysfunctional in terms of performance, costs, or quality, and/ or that are feasible to be managed with existing resources (Dumas et al. 2013).

3.2 The Long Tail

Demonstrating the functional relationship between two quantities, the theory of the long tail originated from statistics to describe distributions of items with strongly varying probabilities of occurrence, e.g. the first 20% of overall items account for 80% of occurrences if the Pareto principle applies (Craft and Leake 2002). We illustrated this kind of functional relationship in Figure 1.

In the business domain, such distributions are fundamental for managing customer demands in local or regional markets (Anderson 2006). Within an analogous environment, enterprises focus on selling the most promising products with the potential to cover fixed costs from maintaining brick and mortar subsidiaries. Due to digitalized customer interactions, the long tail strategy puts a focus on products with a low demand or sales volume, that collectively make up a market share which rivals or exceeds the market volume of traditional bestseller products (Anderson 2006). Thus, managing the long tail can be a key driver for business success. Simultaneously, the increasing importance of IT makes it more feasible for enterprises to unlock new opportunities in highly specialized niches. However, although additional information supports decision-making, the resulting complexity can hamper potential benefits. Thus, tools and methods are necessary that guarantee adequate usability and accessibility. Still, by implementing a long tail strategy, enterprises can eliminate distribution bottlenecks or information scarcity, revealing the natural shape of demand and preferences (Anderson 2006). We adapt the theory of the long tail to the field of BPM, where initiatives are typically centrally managed and thus prioritize high-value processes due to operational constraints. Enabled by information technology, BPM can be decentralized to manage low-value processes in a digital environment (Niehaves and Plattfaut 2011).

3.3 Collaborative Production Models

Due to technological advancements, producing and distributing information has sustainably changed. In fact, isolated communication systems converge to social software systems, altering traditionally bilateral communication relations and enabling users to broadcast information to all participants within a network (Benkler 2006). Thus, decentralized actions, that are both cooperative and coordinated, can be distributed rapidly within networks that are not primarily shaped by safeguarding intellectual property rights. By contrast to the industrial economy, network information economies facilitate participants to produce information independently instead of exclusively consuming it (Slavkovik et al. 2015), resulting in several new production models, such as *peer-to-peer collaboration* and *crowdsourcing*.

A *peer-to-peer network* is defined as a collection of distributed resources connected by a network infrastructure (Wray et al. 1994). Thus, tasks and activities are distributed, without the need for central coordination, where each peer shares its own resources to secure the availability of a network's services and contents (Schollmeier 2001). However, resources are not limited to hardware capacity, but can include skills and knowledge. Thus, *peer production groups* can be formed to deal with a problem or task collaboratively, utilizing complementary resources, such as skills, knowledge, and experiences (Benkler 2006; Raymond 1999). The term *crowdsourcing* describes activities coordinated by an Internet-based platform (Slavkovik et al. 2015). Crowdsourcing intends to outsource activities that were once performed by employees to a large and undefined network of people with an open call (Howe 2006). Outsourced tasks can then be dealt with collaboratively based on peer production.

3.4 Related Work in Collaborative BPM

BPM aims to continuously improve an enterprise's process organization (Hammer 2010). It is considered as a management discipline that requires top-to-bottom commitment and the downward integration of stakeholders (ABPMP 2013; Becker et al. 2013; Dumas et al. 2013; Rito Silva and Rosemann 2012). In line with that, a top management that initiates and supports BPM is among the most important critical success factors when introducing it to an organization (Trkman 2010). Within the academic literature, current approaches are either managed centrally or follow a collaborative bottom-up design. While centrally managed BPM is typically characterized by a top-down design and a prioritization of activities to high-value processes, collaborative approaches suggest to integrate all relevant stakeholders, also including customers, suppliers, and distributers (Feller et al. 2008; von Hippel 2001). As volatile market conditions demand organizational adaptiveness, collaborative approaches become increasingly important and are analyzed regarding organizational, technological, and conceptual aspects (Bruno et al. 2011; Mathiesen et al. 2011; Rito Silva and Rosemann 2012). Scheer and Klueckmann (2009) argue that an organization must enable its stakeholders to participate in decentral BPM and consolidate individual initiatives on an organization-wide platform. Weber et al. (2010) developed a modeling tool to access the long tail of processes but do not provide an in-depth analysis of the long tail's anatomy or methodological support to address the resulting implications. Mathiesen et al. (2011) analyse the potentials of using social technologies when performing activities of the BPM lifecycle. Thus, the authors provide a project-based approach that incorporates synergies of social collaboration and business projects. While the implications drawn show minor analogies to our recommendations on *how* to manage the long tail, the authors do not provide a profound analysis of the conceptual *why* and *when*. In addition, Malinova and Mendling (2013) propose process maps as a visual aggregation of an enterprises process structure to enable its basic understanding. Although process maps aim to document process structures comprehensively, they do not account for the scarcity of resources, the feasibility of managing low-value processes, and the exposure of implicit process knowledge.

4 Impact of the Long Tail in BPM

Examining the long tail in BPM, we define the management of processes as an enterprise-specific utility optimization problem. Although BPM aims to realize benefits in terms of cost reductions, customer satisfaction, and effectiveness, corresponding activities are typically costly and time consuming. Due to the scarcity of resources, enterprises can manage only a certain amount of processes in central BPM initiatives at a time (Dumas et al. 2013). Formula 1 summarizes the optimization problem of an enterprise maximizing its utility *U*, as the difference of expected surpluses *E*[*BPM*(*x*)] and costs *C*(*x*).

$$\max U = E[BPM(x)] - C(x) \tag{1}$$

Initiating BPM initiatives, enterprises typically aim to improve fundamental activities in manufacturing, marketing, communication, and other major operations (Ahmed et al. 1999). In fact, numerous studies indicate a positive correlation between BPM and organizational performance (McCormack and Johnson 2001; Škerlavaj et al. 2007). Since not all processes are equally important, dysfunctional, or feasible, they contribute to the realization of those benefits to different degrees (Davenport 1993; Dumas et al. 2013). Consequently, enterprises face a disadvantageous relationship between the number of processes managed and their marginal surplus, which we formalize by introducing the function *BPM*(*x*). Because BPM comprises different methods, concepts, and tools, the level of expected surpluses depends on an enterprise's ability to deploy a BPM initiative effectively. Potentially influential factors range from organizational requirements, such as the degree of process-orientation or standardization (Lee and Dale 1998; Wüllenweber et al. 2008), to technological requirements, including the operation of process-aware information systems or process automation (Davenport and Stoddard 1994; Harmon 2003). By introducing the variable *a*, we can summarize the degree to which enterprises comply with those requirements as an indicator for BPM effectiveness. However, since BPM relates to process-orientation, several problems can emerge, including the duplication of functional expertise, increased operational complexity, inconsistency in functional decision-making, and a general erosion of efficiency (Silvestro and Westley 2002). Such challenges tend to intensify with the level of organizational complexity, which is mainly driven by product and service differentiation and the degree to which enterprises participate on global markets (Krischke 2011). Thus, diversified enterprises have a more pronounced distribution of expected surpluses, which we have accounted for by introducing the variable *k* into our theoretical model. Eventually, we illustrate the complete BPM function in Formula 2.

$$BPM\ (x) = a\ * x^{-k} \tag{2}$$

Since BPM engages organizational resources, it produces fixed, variable, and opportunity costs, which we summarize with the cost function *C*(*x*). To fully capture its potential benefits, enterprises must address various organizational, technological, and personnel constraints. First, they need to decompose business tasks and activities, analyze their contribution to the business's overall commercial success, and reorganize them into an adequate process-oriented structure (Weske 2012). In addition, BPM success relies on the implementation of process-aware information systems into an integrated enterprise architecture to ensure data and information homogeneity (Jarrar et al. 2000). Ultimately, enterprises need to establish new competencies that enable their employees to use BPM beneficially and to participate in a process-oriented environment (Hammer and Stanton 1999). Since addressing those requirements prior to a BPM project's initiation is pivotal, enterprises face considerable setup costs, which we account for with the variable *S*. However, because activities of the BPM lifecycle can be partly standardized, rely on the executer's experience, and are positively influenced by cross-process knowledge spillovers, we have introduced the variable *z* to our cost function, to integrate economies of scale that emerge as managed processes increase in number. We present the complete cost function in Formula 3.

$$C(x) = x^{\frac{1}{z}} + S \tag{3}$$

Naturally limited by organizational resources, enterprises implicitly focus on high-value processes (Dumas et al. 2013; Kettinger et al. 1997). If an enterprise orders its processes according to their expected surpluses through BPM, a few key processes will account for a great share of potential benefits. However, most business processes alone only create little additional impact. In sum, however, their impact can be considerable and thus represent the long-tail. Figure 1, as introduced earlier, illustrates the resulting long-tailed distribution to explain the functional relationship between processes and expected surpluses. As our model shows, enterprises are willing to manage as many processes as long the expected surplus exceeds the corresponding costs. The *line of manageability* specifies the process by which both determinants break even. While aiming to maximize its financial profits, an enterprise limits its centrally managed BPM initiative to the processes left of this line. This does not entail that processes right of the line of manageability are not improvable through BPM (Dumas et al. 2013). Nevertheless, due to operational constraints, such as a limited number of employees with process management skills or project complexity, BPM must limit the amount of processes, which are centrally redesigned, to a subset of those that yield the most potential surplus: The processes left of the line of manageability.

Processes with a negative marginal return remain neglected as they hamper potential benefits. To determine the line of manageability, we can plot the derivation of the cost function against *BPM*(*x*). Eventually, we can locate x^{LoM}, as the point where the gradients of both functions are equal.

$$C'(x) = \frac{1}{z}\, x^{\frac{1}{z}-1} = BPM(x) \tag{4}$$

$$x^{LoM} = (az)^{\frac{1}{\frac{1}{z}-1+k}}$$

At x^{LoM}, managing an additional process results in a negative marginal return. Thus, it becomes the last process that is included in central BPM. Incorporating further processes would entail that additional staff needs to be hired, trained, or sourced as consultants, or that project communication would be more complex. However, fragmentarily managing a process structure affects an organization in two ways. First, when managing process-oriented organizations, direct or indirect relationships between processes result in mutual dependencies that influence different performance indicators, including process quality or time. Although organizations can manage direct interfaces with key processes within the scope of central BPM initiatives, indirect dependencies remain subsurface and deteriorate an organization's long-term performance. Second, regardless of management costs, the amount of unmanaged processes comprises potentials for creating additional surplus that could improve an enterprise's competitiveness.

Examining the application of collaborative production models for the management of business processes, the measures of costs and benefits are subject to substantial changes that reduce management costs. That consequence stems from the decentralization and distribution of activities, typically organized in a self-regulating system (Benkler 2006). However, the distribution of responsibilities initially results in higher costs for coordination and communication. Furthermore, participants might lack the skills and knowledge required to achieve high-quality results autonomously (Imgrund et al. 2017). Although such drawbacks continuously decrease due to learning effects, we argue that centrally managed BPM can still optimize processes more effectively. This applies especially on high-value processes, which are typically complex and cross-departmental and thus require in-depth knowledge and expert skills (Dumas et al. 2013). However, with the exploitation of tacit process knowledge, collaborative BPM eventually results in positive marginal returns and an advantageous proportion of costs and benefits.

In summary, current BPM initiatives perform best when managing high-value processes and continue to generate considerable benefits until a process's expected surplus cannot compensate for its management costs. To unlock the untouched potential in low-value processes, collaborative BPM can reduce costs and enable enterprises to manage the entire process organization continuously. Figure 2 illustrates the characteristics of central and collaborative BPM approaches, as well as the graphical determination of x^{LoM}, with BPM_{cum} summarizing the cumulative expected surplus when managing process x.

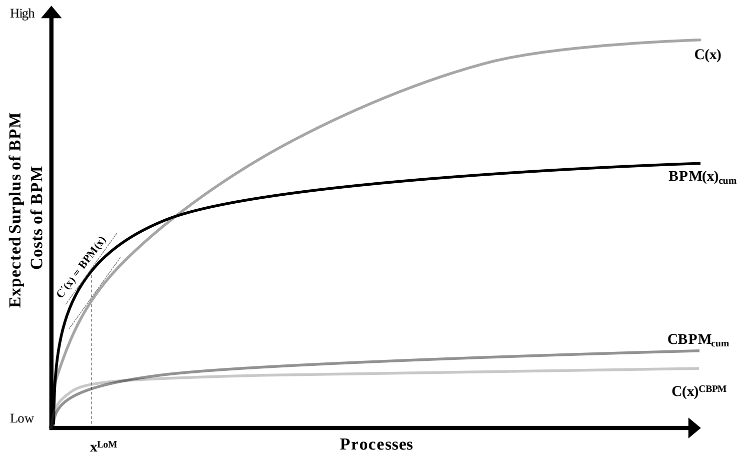

Figure 2. Comparison of Centrally Managed and Collaborative BPM.

Since potential outcomes of our analysis depend strongly on the model's parameters, we evaluate variations of our input values by performing a sensitivity analysis. We evaluate expected surpluses, costs, and the location of x^{LoM} by modifying the parameters of surplus creation, organizational scalability, and economies of scale. *Table 1* summarizes the derived impacts on the predefined optimization problem.

Parameter change	$BPM^{CUM}(x)$	$C(x)$	$\frac{dBPM}{dx} = \frac{dC}{dx}$
Organizational scalability k ⬆	-	/	-
Economies of scale z ⬆	/	-	+
Value creation a ⬆	+	/	+

Table 1. Impacts of Parameter Variations.

Since an increase in organizational scalability results in fewer key processes accounting for a higher share of expected BPM surpluses, the number of manageable processes decreases ceteris paribus. Thus, enterprises with a more pronounced distribution of processes must limit central BPM to a smaller share of processes than enterprises with highly specialized operations. By improving BPM effectiveness, it is more feasible for enterprises to manage more processes. As a result, an established process-orientation and a well-trained workforce can positively influence the scope of central BPM initiatives. With lower economies of scale, management costs per process increase, which yields fewer process that can be centrally managed. By integrating both perspectives, solely an increase in effectiveness enables enterprises to manage more processes and move their line of manageability further to the right. By contrast, an increase in marginal management costs or a more differentiated process distribution negatively affect the number of manageable processes, moving the line of manageability further to the left.

Due to interdependencies within an organizational structure, widening the scope of BPM is essential to secure an enterprise's long-term competitiveness. Accordingly, methods and techniques that enable enterprises to access the long tail of processes within a holistic strategy are necessary. Using implications of our theoretical model, we propose a novel approach based on collaboration and decentralization. When collaboratively managed by process-aware employees, organizations can unlock untouched potentials in the typical dimensions of cost, quality, and time in low-value processes. However, since key processes are essential to an enterprise's overall success, they remain managed by central BPM. Figure 3 illustrates the proposed concept, with overall value creation shown in the shaded areas.

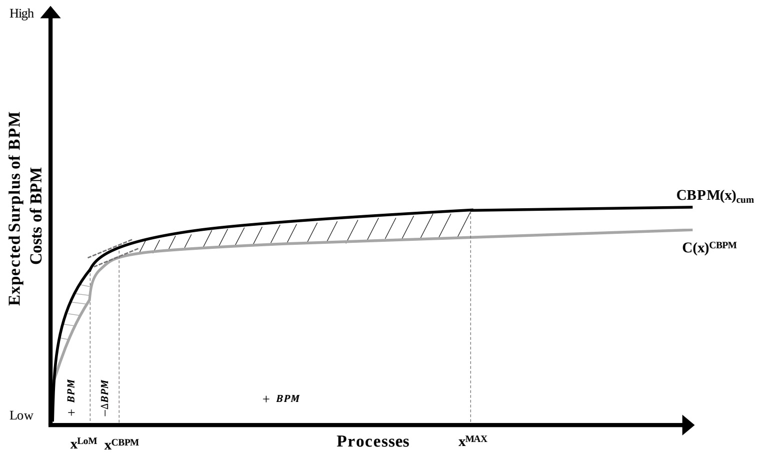

Figure 3. Accessing the Long Tail in BPM.

Integrating both BPM approaches, the cost function, as illustrated in Formula 5, changes significantly, with $z^c > z$, implicating a reduction of management costs due to the introduction of collaborative BPM.

$$C(x)^{CBPM}(x) = \begin{cases} x^{\frac{1}{z}} + S & \lfloor 0, x^{LoM} \rfloor \\ x^{\frac{1}{z^c}} & \lfloor x^{LoM}, \infty \rfloor \end{cases} \quad (5)$$

Analogously, Formula 6 illustrates the resulting surplus function, with $a^c < a$, representing a decrease in BPM effectiveness with the implementation of a collaborative BPM approach, while the constant C indicates no additional surplus after managing x^{MAX}.

$$CBPM_{cum}(x) = \begin{cases} \frac{a}{-k+1} * x^{-k+1} & \lfloor 0, x^{loM} \rfloor \\ \frac{a^c}{-k+1} * x^{-k+1} & \lfloor x^{LoM}, x^{MAX} \rfloor \\ C & \lfloor x^{MAX}, \infty \rfloor \end{cases} \quad (6)$$

Whereas the cost curve in Formula 3 applies to processes left of x^{LoM}, collaborative BPM incorporates the remaining low-value processes. With the realization of x^{MAX}, BPM creates no additional surplus. However, introducing our approach is feasible only for organizations with an sufficient number of processes, marked by x^{CBPM}. Without exceeding that limit in terms of organizational size, enterprises cannot efficiently manage low-value processes and must exclusively manage their processes centrally. Enterprises that exceed that lower limit can reduce their management costs and access long-tail processes.

5 Managing the Long Tail in BPM

Regarding the long tail of processes, it appears that many enterprises do not fully capture the potential benefits of their BPM activities. Instead of viewing central and collaborative BPM as being mutually exclusive, implications from our theoretical model suggest their integration. In fact, by augmenting centralized BPM with collaborative production models, enterprises can increase the profitability, scope, and richness of BPM by improving the transparency, accessibility, and manageability of previously neglected areas of their process architecture (Bruno et al. 2011). To define guidelines that enable enterprises to manage all of their processes, we reviewed the academic literature (Webster and Watson 2002) to integrate our recommendations into established BPM approaches. In particular, we adapted the BPM lifecycle model of Dumas et al. (2013), who describe BPM as an iterative procedure including the tasks of process *identification*, *discovery*, *analysis*, *redesign*, *implementation*, and *monitoring and controlling*.

To practically scrutinize the theoretical implications of our model, we conducted continuous empirical observations at a German telecommunication company. Having initiated BPM in 2010, the company has sought to increase its operational performance by substantially improving communication and coordination among its employees. With a lightweight process modeling infrastructure as a central collaboration platform, every employee had the opportunity to participate in BPM activities. Further leveraged by a rigorous bottom-up strategy and a comprehensive educational program, more than 2.000 modelers constructed more than 12.000 business process models within the scope of process identification and discovery. Since the platform was equipped with several sorting and ranking functionalities to organize the resulting process repository, the company could facilitate knowledge diffusion and collaborative problem solving to uncover tacit process knowledge and cross-departmental interfaces. Eventually, each stakeholder participated in process redesign and independently implemented optimization potentials into the company's as-is structure. Although that procedure noticeably improved communication and coordination among process stakeholders, the company's efforts essentially focused on process identification and discovery, not fully harnessing potential benefits from subsequent phases of the BPM lifecycle.

Process identification. During *process identification*, enterprises determine their process architecture by identifying and prioritizing processes with respect to their business goals (Dumas et al. 2013). In centrally managed initiatives, organizations assign processes to their corporate process architecture and classify them into the categories of core processes, support processes, and management processes, which typically generates a focus on high-value processes (Dumas et al. 2013). Thus, the enterprise can appropriately address only a subset of its process organization and necessarily neglects low-value processes along the long tail. To unlock existing potentials by actively managing these processes, enterprises must perform BPM holistically by integrating both top-down and bottom-up procedures (Bruno et al. 2011). However, as Figure 3 illustrates, managing long-tail processes is feasible only if an enterprise's number of processes exceeds x^{CBPM}. Since resource constraints limit the scope of central BPM, managing processes beyond x^{CBPM} requires a decentralized approach, by which the participation of stakeholders enables organizations to collect information and knowledge more efficiently.

Recommendations. Based on the application of *collaborative productions models*, such as crowdsourcing or peer production, an *organization-wide platform* to share, distribute, and reuse individuals' information can reduce resource consumption (Benkler 2006). However, each enterprise must evaluate the profitability of managing long-tail processes (cf. Section 4) by initially *determining* x^{LoM}. As any additional process is identified collaboratively, a central platform should consolidate and distribute the conducted process knowledge (Rito Silva and Rosemann 2012). Because multiple stakeholders can participate in a single process, the platform should provide functionalities to *detect redundancies and inconsistencies*, as well as features to structure and organize the resulting process model repository. After initiating a holistic BPM approach, the organization should aggregate the information with an *indicator measurement system* to enable a dynamic evaluation of each process's dysfunctionality, importance, and feasibility. Providing *adequate incentives*, a *well-defined rollout strategy*, and the active *communication of expected benefits* can further increase the employees' willingness to participate and positively influence process coverage and the quality of results (Bruno et al. 2011).

Process discovery. During *process discovery*, the as-is-structure of an enterprise is modeled and documented (Dumas et al. 2013). In centrally managed BPM, the scope of process models encompasses only the predefined process architecture, and specialized process analysis, who collaborate closely with process stakeholders, typically perform the modeling task (Dumas et al. 2013). However, the long tail comprises a high amount of process models that exceed the capabilities of central BPM and thus requires collaboration to support process discovery and modeling.

Recommendations. To facilitate collaboration in process modeling, enterprises should provide an *environment that enables stakeholders to explicate tacit process knowledge*. Particularly, it should support the creation, viewing, and sharing of process models (Imgrund et al. 2017) and *provide adequate knowledge management functionalities* (Jung et al. 2007). By decentralizing process discovery, more modelers can participate in formalizing an enterprise's process structure. Although specialized process analysts typically ensure an adequate modeling quality in central initiatives (Dumas et al. 2013), this should be addressed by an *educational program* in collaborative approaches, teaching necessary methods and skills to use the modeling environment productively (Imgrund et al. 2017). To support the modeling task itself, an enterprise-specific ontology and adequate notational specifications can provide guidance for model design and ensure their interoperability (Bruno et al. 2011). However, since predefined specifications cannot address all violations, the platform should provide adequate mechanisms to *automatically validate process models and to detect severe quality-related issues*. As organizations perform central and decentral initiatives simultaneously, they should aim to *integrate and organize the resulting process repository* and map each process onto the corporate process architecture. As numerous implications can be drawn from process data, e.g. on interfaces or the involved stakeholders (Rito Silva and Rosemann 2012), the data should further be utilized to improve the introduced indicator measurement system. To encourage employees to participate in the modeling task, the environment should provide adequate usability and accessibility and integrate smoothly into the existing enterprise architecture to *facilitate organization-wide data and information homogeneity* (Imgrund et al. 2017; Mathiesen et al. 2011). However, since process modeling can be complex and time-consuming, enterprises must provide adequate *incentives*, e.g. by implementing a social rewarding system (Bruno et al. 2011).

Process analysis. During *process analysis*, enterprises analyze and evaluate as-is-models regarding their importance, health, and feasibility, ideally by using the indicator measurement system. Due to operational constraints, central BPM focuses only on a subset of an enterprise's processes based on the predetermined prioritization (Dumas et al. 2013). In extending BPM to long-tail processes, enterprises face unknown challenges. First, performing process analysis often requires in-depth knowledge of the organizational structure (Dumas et al. 2013). Second, since process analysis can be a complex task with several possible pitfalls (van der Aalst 2015), returns of assigning additional resources are mostly uncertain. Third, neither results from our empirical investigations nor findings from the literature provide best practices for evaluating processes collaboratively. However, process analysts in central BPM are typically not able to cope with the high amount of long-tail processes. By contrast, analysis performed by process stakeholders enables more timely and well-founded decisions (Berthold et al. 2010). Thus, enterprises should provide adequate mechanisms for collaborative process analysis and decision-making.

Recommendations. Given the importance of key processes for an enterprise's performance, their analysis and evaluation should remain centrally managed. Consequently, enterprises should provide an additional *standalone solution* focusing on the collaborative analyses of processes with concepts adapted from the discipline of knowledge management. Thus, effective *mechanisms for knowledge diffusion, communication, and coordination* among organizational members are necessary (Bruno et al. 2011; Imgrund et al. 2017). Due to limited organizational resources, it is hardly feasible for enterprises to centrally monitor all collaboratively generated process models. Thus, corresponding activities should be transferred into a *self-organizing system following the paradigm of peer production* (Kittur et al. 2013). To facilitate self-organization, enterprises should provide supportive techniques and methods, e.g. by highlighting organizational challenges supported by an *organization-wide commenting and voting system*. In addition, activities within peer production groups should account for best practices from related domains, e.g. as suggested by Raymond (1999). Pouwelse et al. (2008) further propose providing the functionalities of social networks to facilitate the adoption of peer production in organizations.

Process redesign. *Process redesign* involves generating, analyzing, and selecting multiple change options based on the issues identified by performance measures. Specialized process analysts use those modifications to transform the as-is-structure into a to-be-concept. Because the task of process redesign requires a high degree of creativity, enterprises cannot approach it in a purely systematic way (Dumas et al. 2013). Thus, central redesigning is typically limited to processes that potentially yield the highest expected benefits from optimization (Bruno et al. 2011). To address processes in the long tail, it is hardly feasible for enterprises to centrally pursue all kinds of optimization potentials from all stakeholders involved. Thus, a bottom-up approach is necessary to facilitate information and knowledge sharing and to eliminate communication bottlenecks (Bruno et al. 2011).

Recommendations. Similar to process discovery, enterprises can facilitate collaboration by providing an educational program, a platform that supports knowledge management, mechanisms to control for the quality and structuration of process models before, during, and after their documentation, and a seamless integration into their enterprise architecture. However, due to the complexity of the redesigning task, required skills typically exceed the capabilities of non-specialized stakeholders (Imgrund et al. 2017). Thus, enterprises should *capture benefits from collaboration,* as concepts, such as the wisdom of the crowd (Surowiecki 2005), collective intelligence (Lévy 1997), and user co-creation (Prahalad and Ramaswamy 2004), suggest. To *utilize network effects*, enterprises can introduce those concepts by using collaborative production models (Vukovic 2009) and thereby distribute organizational challenges to broader audiences to uncover tacit process knowledge and enrich decision-making with the integration of heterogeneous viewpoints (Dutton 2008). Accordingly, enterprises should *provide the functionalities of social networks*, typically including commenting, sharing, and voting, as well as mechanisms to focus their resources towards certain organizational challenges (Bruno et al. 2011; Imgrund et al. 2017). The environment should further *provide an adequate degree of information content*, e.g. by presenting metadata, such as a process's short description, process owners, or its stakeholders (Imgrund et al. 2017). To monitor the overall development, enterprises should track each modification with a *version management system*. As a result, they can recognize long-term shifts in requirements and adjust their overall strategy accordingly. As redesign alters process characteristics, e.g. in in terms of orchestration, automation, or stakeholder involvement, their importance, health, and feasibility should be reassessed.

Process implementation, monitoring, and controlling. During *process implementation*, enterprises perform necessary modifications to transfer the to-be-concept into the as-is-structure, typically with the aim of utilizing various kinds of optimization potentials, including process automation and increases in organizational productivity and efficiency (Dumas et al. 2013). However, employees' workflows and routines can experience distinct changes that require adequate organizational change management. With processes implemented and running, the phase of *process monitoring and controlling* should involve the evaluation of their performance against predefined criteria. Results can allow enterprises to align their processes to corporate goals, customer needs, technology, and market conditions (Dumas et al. 2013). Thus, they address identified problems either by deploying corrective actions or by assigning poorly performing processes to rerun through the BPM lifecycle (Dumas et al. 2013). By performing process implementation and monitoring, enterprises can benefit from specialization and synergies in centrally managed BPM initiatives. However, due to decentralization and collaboration, such tasks become increasingly complex and typically exceed the capabilities of central BPM by requiring superior communication and coordination.

Recommendations. To implement redesigned long-tail processes, enterprises should facilitate collaboration by providing adequate tool support, which can *enable organizational stakeholders to communicate and allows for a precise coordination of resources*. In central BPM, enterprises perform change management to influence the adoption decisions of stakeholders affected by organizational adaptations.

However, naturally linked to the top-down paradigm, enterprises can considerably reduce change management efforts in decentralized approaches, as decision-making is performed collaboratively by integrating multiple stakeholders' preferences (Bruno et al. 2011). Several authors have highlighted that the degree of process automation can reduce future BPM efforts (Becker et al. 2013; Dumas et al. 2013; Trkman 2010). Thus, enterprises should evaluate each process concerning its automation potential and consider the distinct dependencies between their implementability and process model quality. Consequently, in aiming to *capture long-tail automation potentials*, relevant process models should be subject to more accurate conformance checks. To further reduce quality-induced issues, *a group of peers should review each process model for final approval*. As a result, stakeholders need adequate incentives and sufficient skills to encourage their regular participation in recurrent reviewing cycles. Automating long-tail processes further requires a *seamless integration of the executing process engine and the modeling environment* (Imgrund et al. 2017). Failing this, modeling will remain an end in itself and resulting to-be processes must be transferred to an execution environment before their actual implementation. To *ensure the availability of sufficient resources*, enterprises should further define mechanisms that automatically allocate organizational resources and thus support business process execution. This entails that enterprises should introduce modified processes only in parallel to the established process for testing purposes and preserve a process's older version as a fallback solution. Since simultaneously performing central and collaborative BPM can result in considerable organizational challenges, *effective mechanisms to control and monitor the entire process organization* are crucial. Thus, we argue that enterprises should perform corresponding functions centrally, yet continue to enable stakeholders to communicate perceived weaknesses in their specific area of responsibility. Because an integrated environment typically operates on a central database, enterprises can further improve performance monitoring by using techniques of data mining to detect patterns and anomalies within the process data (van der Aalst 2011). *Automated alarm mechanisms* that call for a process owner's attention or, if necessary, shut down the process completely should complement those oversights. Since each process can cause a series of reactions within the interdependent process organization, enterprises should form emergency BPM task-forces to address major violations and to guarantee short service and re-engineering times. To *facilitate participation*, periodical reports should communicate improvements to the entire organization.

6 Summary, Limitations, and Outlook

In this paper, we have examined the long tail of processes from both theoretical and methodological perspectives. Regarding our first research question, we introduced a novel approach to conceptualize the long tail and defined BPM as a utility optimization problem. By analyzing the decision's parameters, we have reduced the problem's complexity to the determinants of costs and expected surpluses through BPM. Thus, enterprises are willing to manage as many processes as the expected surplus exceeds the corresponding costs. The process, for which both determinants break even is specified by the line of manageability. Assuming that organizations have rational agents, who aim to maximize their financial profits, we have provided a theoretical foundation on an enterprise's BPM decision-making. Current BPM approaches focus on a limited amount of high-value processes, thereby leaving many low-value processes neglected. Since the amount of low-value processes typically exceeds the number of centrally managed processes, enterprises do not capture this untouched optimization potential due to operational constraints. Collaborative production models can yield positive returns in the large when centrally managed initiatives fail due to coordination overheads and complexity. Consequently, we have integrated collaborative production models into the BPM lifecycle, providing a holistic method for enterprises willing to manage not only a small prioritized portion of their processes but their entire process organization. To address our second research question, we derived implications from our theoretical model and transformed them into three main guidelines:

First, organizations need to implement a bottom-up organization as an extension to central top-down management approaches. Due to the bottom-up design of BPM, management costs can be reduced and the cost-benefit-ratio can be improved substantially. *Second*, collaborative production models must incorporate economics of scale by enabling employees to benefit from peer production. *Third*, enterprises must conform with several technological requirements to ensure employee participation. This is addressed by a properly working process modeling environment, where employees can access, edit, evaluate, and monitor, collaboratively interact with, and share process models.

Our approach is not without limitations. We do not claim that our model provides theoretical proof but rather to be a theoretical means of visualization and argumentation. Thus, our contribution should be looked at as exploratory research, requiring more in-depth analyses to test and explain causal relationships and to internally validate the proposed model. Abstracting from real-world observations, relationships were derived from rich interpretations, which were guided by findings within the academic literature. However, omitted parameters can influence the outcomes of our analysis. While proposing to prioritize processes towards a fixed set of generic criteria, other aspects could inherently bias decision-making. In line with that, other scenarios for BPM have been neglected, e.g. to facilitate software implementation projects or to comply with relevant laws and regulations. Also, we make no statement about the actual relation of surplus in value and cost. It is up to the individual enterprise to monetarily value their surplus. We have introduced x^{LoM} as the line of manageability. x^{LoM} does not have to be the optimal point (i.e. process) to switch from a centralized to a collaborative production model as it does not only introduce a new cost function but also a new (and lower) surplus on value curve. This is an optimization problem, which we have not addressed in this research. We further assume that economies of scale apply when managing processes. However, if there is a negative correlation of process value and management complexity, the cost function takes a convex path, resulting in increasing marginal cost. Further work to validate our theoretical framework must be accomplished through empirical investigations using a research design for theory testing.

Accessing the long tail, enterprises face complex challenges in terms of managing process quality and information processing. While collaborative production systems can generate innovative solutions, effective measures to evaluate outcomes towards their accuracy and applicability must be deployed. Thus, corresponding efforts for coordination and quality management could exceed their assumed impact on the overall implications. However, when accessing a large amount of low-value processes, internally integrating them into collaborative BPM is only one out of many choices. In fact, businesses face a make-or-buy decision, with the possibility of outsourcing processes to external service providers.

As a next step, we will complement our DSR with Action Design Research (Sein et al. 2011) to evaluate our findings in a real-world scenario at a German telecommunication provider. While the company already models its long-tail processes as described above, it does not harness improvement potentials from collaborative production models to improve their process long tail yet. First, we will validate our alpha version with selected practitioners before making the beta version available to end-users and devise the final artifact.

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