The Key Contributions of the Operations Management and Information Systems Disciplines to Business Process Management

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Abstract—**Based on a narrative review, this paper synthesizes the main contributions of the operations management and the information systems disciplines to the business process management literature. Our findings show that the operations management discipline has been the main contributor to the topics of business process definition, business process standardization, business process outsourcing/offshoring, Six Sigma, and business process management theories while the information systems discipline has been the main contributor to the topics of business process reengineering, the role of information technology, and the business process management nomological network.**

Keywords-business process management; information systems discipline; operations management discipline

I. INTRODUCTION

The study of business processes has been a long-standing concern for members of academia and practitioners [1]. A business process can be defined as a lateral or horizontal organizational form that encapsulates the interdependence of tasks, role, people, departments and functions required to provide a customer (either internal or external) with a product or service, through the transformation of inputs into outputs [2][3][4][5]. The term customer refers here to both external consumers of the organization and internal recipients at linkage point between processes, as output from upstream processes become the input of subsequent processes [3][4]. This wealth of attention on business processes has fostered a vast literature centered on business process management (BPM). BPM can be defined as a strategy-driven organizational initiative to improve and (re)-design business processes to achieve competitive advantage through changes in the relationships between management, information, technology, organizational structure, and people [6][7].

Two disciplines have mainly contributed the BPM literature: the operations management (OM) and information systems (IS) disciplines. The OM discipline is concerned with overseeing, designing, and controlling the process of production and redesigning business operations in the production of goods or services by considering the acquisition, development, and utilization of resources. The IS discipline examine the phenomena that emerge when technology and peoples interact. While both disciplines have brought significant contributions to BPM, their respective efforts are most often conducted in silo and are rarely integrated into a common whole. Consequently, we still lack a comprehensive understanding of the current state of knowledge on BPM. The objective of this paper is thus to synthesize the main contributions of the OM and IS disciplines in order to comprehensively detail the state of knowledge on BPM.

The findings exposed in this paper are based on a narrative review. A narrative review provides a verbal summary of previously published research on a particular topic of interest by either focusing on related concepts and theories, research methods or research outcomes [8]. Narratives reviews "serve a scientific field by providing a much-needed bridge between the vast and scattered assortment of articles on a topic and the reader who does not have the time or resources to track them down [9, p. 311]". In addition, narrative reviews can serve as an appropriate starting point for future inquiries and research developments [10].

The rest of the paper is organized as follows. Section 2 presents a brief history of the BPM literature to demonstrate that today's understanding of business processes and their improvement highly rest on the intertwined findings of the OM and IS disciplines. Then, based on this understanding, we use a narrative approach in Section 3 to detail the main contributions of the OM and IS disciplines along the four main sub-streams of the BPM literature: business process standardization (BPS), business process reengineering (BPR), Six Sigma, and theorizing efforts. The paper concludes with a presentation of research limits and future research avenues.

II. A BRIEF HISTORY OF BUSINESS PROCESS MANAGEMENT

Initially, the study of business processes emerged as a central element of total quality management (TQM) [3][7]. The history starts with the seminal work of quality management proponents such as Ishikawa [11], Deming [12], and Juran [13]. In essence, these works focused on "the creation of an organizational system that fosters cooperation and learning for facilitating the implementation of process

management practices, which in turn, leads to continuous improvement of processes, products and services, and to employee fulfillment, both of which are critical to customer satisfaction, and, ultimately to firm survival [14, p. 473]". Subsequent writings by Davenport and Short [15] and Hammer [16] highlighting the necessity to focus on business processes reengineering (BPR) reinforced and broaden the initial interest on the subject [7]. It was also at this point in time that the interdependent relationship between IS and BPM was explicitly acknowledged [15] enticing the OM and IS communities to work together to improve our understanding of BPM. This is certainly exemplified by the adjacent publication of special issues on the topic of TQM in the Academy of Management Review in June 1994 and the Journal of Management Information Systems in 1995, two top journals in their respective discipline.

Today, with the increasing emphasis placed on integrating business Web sites with backend legacy and enterprise systems, the management of business processes remains an important topic in the IS discipline [17] while the need for ambidextrous organizations puts BPM to the forefront in the OM and management discipline [3]. Hence, even though the initial idea of BPM emerged from the OM discipline [15], today's understanding of business processes and their improvement highly rests on the intertwined findings of the OM and IS disciplines. Two reasons explain why BPM has been predominantly researched in these two disciplines. First, researchers within both the OM and IS communities have long recognized the systemic nature of the firm and the need for a holistic approach in its management [18][19]. Hence, studying business processes, which span across intra-organizational and in certain circumstances inter-organizational boundaries, is important in both disciplines. Second, because business processes span across internal and external organizational boundaries and because one of the key purposes of information technology (IT) is to reduce coordination cost across organizational entities, both disciplines have recognized the complementary if not symbiotic nature of business processes and IT [15][20][21], creating a state were both communities have mutually reinforced each other's work and interest on BPM.

III. A Detailed Narrative of Business Process Management and Key Contributions

Having briefly exposed the history of BPM and the importance of both the OM and IS disciplines to fully comprehend the improvement of business processes, we now examine the BPM literature in greater detail to show the contributions of both disciplines along the four critical sub-streams of the BPM literature. To do so, we first show that the BPM literature initially evolved into two separate sub-streams, BPS and BPR while a third sub-stream entitled Six Sigma that reconciles diverging views from the BPS and BPR sub-stream appeared more recently. Next, we detail the contributions within the fourth sub-stream that has focused on theorizing efforts to provide BPM explanations and to develop a BPM nomological network in an attempt to alleviate the previous three sub-stream's shortcomings. We

conclude by synthetizing the key contribution of both disciplines to BPM.

A. The business process standardization, business process reengineering and Six Sigma sub-streams

Various programs like TQM, ISO 9000, the Malcom Baldrige Award, Six Sigma and BPR have been developed to help managers improve their business processes [3][14][22]. However, despite the fact these programs share several similarities (i.e., they all aim to improve business processes), they also differ in scope and approach [3] as they differ significantly in the magnitude of change sought-after to improve business processes [3][23]. For instance, TQM, ISO 9000, and the Malcom Baldrige Award programs have been depicted as programs seeking incremental changes [14][23][24] whereas BPR programs have been described as programs aiming for radical changes [6][16][25]. This major difference may be explained by the fact that proponents of both types of programs have different backgrounds. Indeed, TQM, ISO 9000, and the Malcolm Baldrige Award advocates relying on their vast experience with statistical process control continue to argue for incremental changes while BPR advocates relying on their IT implementation experience prone for radical changes [16][18]. Consequently, this divergence in scope and approach has led to the emergence of two key sub-streams in the BPM literature. The first, BPS, is mainly addressed in works from the OM discipline while the second, BPR is mainly addressed in works from the IS discipline. The BPS sub-stream has mainly focused on the standardization of business processes and process outsourcing/offshoring (BPO) while the BPR sub-stream has mainly addressed the reengineering of business processes and the role of IT in BPM. More recently, a third sub-stream focusing on Six Sigma has emerged. With its roots in the OM discipline, this sub-stream reconciles findings from the BPS and BPR sub streams.

1) Business Process Standardization

The cumulative and extensive work of TQM and other OM programs (e.g., ISO 9000, the Malcom Baldrige Award) has led to the identification of three key principles for business improvement, namely focus on customers and stakeholders, participation and teamwork throughout the organization, and focus on continuous improvement and learning [26], as well as the creation of three key BPM components: (1) process activity and flow standards, (2) process performance standards and (3) process management standards [4]. These principles and components have enabled a more efficient approach to improve business processes while simultaneously allowing for the emergence of BPS [27]. BPS can be defined as the degree to which work rules, policies and operating procedures in an organization, as established by consensus and approved by a recognized body (e.g., government agency, industrial consortia) [28], are formalized and followed [29]. BPS offers several important benefits to organizations [27]. Within an intra-organizational context, BPS facilitates communications on business operations, enables smooth handoff across process boundaries, and makes possible comparative measures of performance. Likewise, within an inter-organizational

context, BPS makes commerce easier by improving communication, enabling more efficient handoffs and allowing performance benchmarking [4]. As such, BPS has been shown to foster economies of scale, organizational learning, and overall organizational effectiveness [27].

Furthermore, when pushed to the extreme, the idea of BPS has also led some protagonists from operations management to believe that business processes could be outsourced/offshored in order to allow firms to reap further benefits by concentrating their efforts on their core competencies [4][30][31]. BPO can be defined as the delegation of one or more business processes to an external provider, whether onshore or offshore (Mani et al., 2010). Recent findings emanating from the OM and IS disciplines, however, suggest that reaping benefits from this approach is not as straightforward as previously expected [27][32] and that these benefits may only be temporary. Thus, organizations seeking to gain a sustainable competitive advantage should proceed carefully in embracing BPS and/or BPO practices [33][34].

2) Business Process Reingeneering

BPR can be defined as an approach "for initiating and managing "radical" changes in business processes [35, p. 32]". Hence, with the help of statistical and quantitative analysis, BPR advocates aim to fundamentally rethink and redesign business processes in order to obtain dramatic and sustainable improvements in contemporary measures of performance (e.g., quality, cost, service, lead time, outcomes, flexibility, innovation) [25][26]. On their quest for radical changes, BPR advocates have directed their attention away from business processes themselves and started to look for solutions that could significantly alter them. This resulted on a strong emphasis on IT due to its ability to reduce coordination costs across internal and external organizational boundaries [15]. Accordingly, BPR advocates are mostly IS researchers. They have proposed five distinctive steps, one of which is dedicated to IS, to help managers reengineer business processes [15]. As a first step, managers should develop a business vision and define clear process objectives. Second, managers should identify the process/processes to be redesigned. Third, managers should develop an understanding of existing processes and measure them. Fourth, managers should identify key IT levers and fifth, managers should design and build a prototype of the improved business process/processes. By examining extensively the key role of IT in improving business processes, BPR advocates were able to determine that IT contributes to the reengineer of business processes in two ways. First, by forming an organization's information backbone that spans across functional level and enables easier communication. Second, by providing capabilities that support key BPR activities, such as modeling, optimizing and validating [6][7][17]. Hence, IT can be seen as both an enabler [20][25][36] and as a facilitator [37][38] of BPR. More precisely, IT plays an enabler's role when it is used as a fundamental component of an improved process whereas IT plays a facilitator's role when it supports the process improvement process without being included as a fundamental component of the final solution (i.e., the new or improved process doesn't require IT). For example, improving the customer payment process may rest on the added capability of information technologies that allows for automatic payment between firms (i.e., IT enabler's role) whereas improving a product assembly process could be done trough the use of statistical software in order to create a new optimal assembly sequence. In this latter example, the assembly process remains IT free but IT played a key role in improving the process (i.e., IT facilitator's role). Evidently, both roles are not mutually exclusive and IT can, in many cases, play both roles simultaneously.

Despite showing the great power of IT, these efforts have also highlighted the limits of technology. Indeed, these efforts have demonstrated that IT should not be a panacea to organizational process improvement problems but rather be considered as a part of a broader approach. That is, implementing IT just for the sake of it is not going to improve a business process. Having IT in mind as either an enabler, facilitator or both, organizations should aim to remodel their processes, in a way that the new processes developed answer business needs [20][38]. Furthermore, BPR efforts have also highlighted that IT can be a barrier to business process improvement. For instance, a firm lacking interoperability between its data from different information systems was unable to implement an improved version of its replenishment processes because its selling systems could not be readily integrated with ordering and logistics systems [36]. Taken as whole, these complementary findings indicate that anchoring BPR or BPM on IT alone is not enough to provide a sustainable competitive advantage [20][38] while the long term consequences of IT have to be considered since today's solution can become tomorrow's problems.

3) Six Sigma

Despite being mainly treated in two different disciplines, and characterizing business process change in a dichotomous manner where the relationship between incremental and radical changes is mutually exclusive, the BPS and BPR sub-streams now seem to be converging. Indeed, recent characterizations of business process change in the BPM literature now follow a less strict standpoint and depict business process changes on a continuum ranging from incremental to radical changes, making the simultaneous pursuit of both types of changes possible [6][7][37]. This reconciliation between BPS and BPR advocates highlights the similarities between the two programs. That is, both BPS and BPR rest on the common purpose of transforming business processes by measuring, improving, and rationalizing each individual process as well as the handoffs between the different processes [3][7][21]. This convergence also highlights that the improvement of business process is grounded in three main common practices: mapping processes, improving processes, and adhering to systems of improved processes [3].

The reconciliation between BPS and BPR is also at the hearth of the emergence of new sub-stream on Six Sigma and may explain why organizations such as 3M, Ford, Honeywell and American Express already pursuing TQM and BPR programs were able to reach further benefit by adopting Six Sigma [24]. Indeed, because Six Sigma allows

organizations to be ambidextrous, that is to support simultaneously the need for exploration and control, this innovative program combines the advantages of BPR and BPS while minimizing their respective shortcomings [3][24]. Six Sigma can be defined as a "project-driven management approach to improve the organization's products, services, and processes by continually reducing defects in the organization [39, p. 1]". As such, the main difference between BPS, BPR and Six Sigma rests in how business improvement tools/techniques are implemented in the organization, rather than in the underlying philosophy or the tools/technique employed to improve business processes [24]. More precisely, Six Sigma differs from BPR as it places more emphasis on data driven decisions rather than on statistics and quantitative analysis [26]. On the other hand, Six Sigma differs from BPS on the following aspects. First, it provides a more structured and rigorous training development program for managers. Second, the business process and its improvement is owned by a single "champion" in Six Sigma rather than by a multitude of worker in BPS. Third, Six Sigma is cross-functional and looks for verifiable return on investment whereas BPS is a process based methodology that lightly focuses on financial accountability [26]. Thus, besides providing a platform to allow for both incremental and radical changes, Six Sigma also suggests that an integrative framework of BPM is coming of age. It is important to note however that, to this day, the topic of Six Sigma has mainly been discussed in the OM disciplines while being addressed in only a very limited number of IS studies [40].

B. The Sub-Stream on Theorizing Efforts

Research within the three previous sub-streams has fostered our knowledge on business process and BPM. However, although essential, these efforts remain insufficient to provide a comprehensive understanding of business process improvement. This is certainly exemplified by the fact that numerous if not the majority of organizations adopting one or many of the BPM programs mentioned above actually fail to reach expected benefits [1][6][41][42]. This phenomenon has created a productivity paradox with some organizations reaping significant benefits from BPM while others actually losing money. This issue is further exacerbated by the limited number of empirical research conducted to assess the effectiveness of BPM programs which has resulted in a state where BPM programs tailored to improve business processes are usually developed and adopted on the basis of anecdotal evidence rather then scientific knowledge [3][7][14]. Put differently, these previous observations indicate an evident lack of BPM theorizing [1][14][22]. In accordance with this assertion, several authors have observed that the vast majority of the studies on business process and BPM remains to this day highly prescriptive in nature and thus fails to highlight the underlying mechanisms behind the various programs developed and their respective limits [3][22].

Recognizing the need for theory, the OM and IS disciplines have conjointly begun to theorize on BPM. To do so, they have adopted various approaches: identifying BPM/IT critical success factors [1][41], identifying BPM antecedents [6], linking BPM with existing management theory [22], building BPM theory by using grounded theory [24] and censing current methodologies, techniques and tools [5] in an effort to resolve the issue. Representative findings from these theorizing efforts are summarized in Table 1.

Four broad assertions can be gleaned from these theorizing efforts. First, BPM builds from knowledge rooted in multiple disciplines including management as strategy, organizational behavior and psychology, industrial economics and purchasing, innovation, organization design and human resources, sociotechnical design, quality and industrial engineering, marketing and finance [3][7]. Considering that the idea was to foster a holistic approach to organization management, it is not surprising that business process theorizing efforts have drawn from multiple disciplines that, altogether, allow for the required 360 degrees view of an organization. Second, theorizing efforts aiming to explain the impact of BPM on organizational performance position the construct of business process management in a complex and dense nomological network [3][6][7][35]. A clear insight stemming from these proposed nomological networks is that researchers agree on the start and end point of BPM. Specifically, proposed BPM nomological networks typically build on the premise that BPM initiatives should be triggered by a strategic vision and aim for customer focused outcomes [6][7][14][22].

TABLE I. REPRESENTATIVE INSIGHTS FROM BPM THEORIZING EFFORTS

Authors (discipline)	Insights
[1] (IS)	Development of a theoretically rooted framework identifying business process management critical success factors.
[3] (OM)	Development of a theoretical contingency approach to business process management based on the constructs of process management, technological innovation, organizational environment, organizational form and organizational adaptation.
[5] (IS)	Identification of a comprehensive list of methodologies, techniques, and tools supporting business process management.
[6] (IS)	Empirical validation of Kettinger and Grover's [7] theoretical framework highlighting the validity of the framework.
[7] (IS)	Development of a multilevel theoretical framework of business process change management including 10 elements and their relationships
[14] (OM)	Identification of the concepts and their relationships underlying the Deming Management Method.
[18] (OM)	Characterization of business processes along the dimensions of work processes, behavioral processes, and change processes.
[22] (OM)	Development of a theoretical framework highlighting the similarities between the total quality and management literature based on the main dimensions of the Baldrige Award.
[24] (OM)	Development of a Six Sigma framework including 5 elements and their relationships based on the identification of an underlying theory on Six Sigma.
[35] (IS)	Development of a taxonomy of BPR strategies based on a process alignment model comprising four lenses: process, strategy, information systems, and change management.

Third, contrary to early prescriptive attempts that prone the universality of BPM programs, current efforts clearly highlight that BPM programs are context dependent. The identified contingency factors generally include elements both internal and external to the organization [3][6][7]. Internal factors can be categorized in terms of organizational structure, management, information and technology, people, and business processes [6][7] while external factors usually refer to environmental conditions (e.g., economic conditions, industry competitiveness, innovations) [3][7]. As such, a careful reflection must be made before adopting one or many BPM programs [3]. Lastly, although they differ slightly, the contribution of the OM and IS disciplines to BPM theorizing efforts are complementary. Indeed, members of the OM discipline have mainly aimed to identify and define BPM underlying theories whereas members of the IS discipline have mainly aimed to define BPM's nomological network.

C. Synthethizing the key contribution of the operation management and IS discipline

Having described the four sub-streams of the BPM literature, their respective key research topics and highlighted the role of the OM and IS disciplines in regards of each of these topics, we can now compare each discipline's contribution towards the improvement of business processes. Table 2 synthetizes the results of this comparison.

TABLE II. THE DISTINCTIVE CONTRIBUTION OF THE OPERATIONS MANAGEMENT AND IS DISCIPLINES ON BUSINESS PROCESS KNOWLEDGE

Topic	OM	IS	Dominant discipline
Definition of processes	[4][1][18] [21]	[2]	OM
Definition of business process management	[1][18][43] [44][45][46]	[6][7]	Equivalent
Business process standardization	[3][4][24] [27, 28]	[2][34]	OM
Business process outsourcing/ offshoring	[4][30][31] [32][33]	[37][38][47]	OM
Business process reengineering	[15][41]	[17][20][23] [25][36][48]	IS
The role of IT	[15][43]	[5][6][7][17] [20][35][36]	IS
Six Sigma	[24][26] [45][46]	[39]	OM
BPM theories	[3][14][22] [24] [45][46]	[6][7]	OM
BPM nomological network	[3][24]	[6][7][35] [49]	IS

Keeping in mind the results described above, one can see that the OM discipline played a prominent role in the topics of business processes definition, BPS, BPO, Six Sigma, and BPM theories. On the other hand, the IS discipline played a prevalent role in the topics of BPR, the role of IT, and BPM nomological network. Finally, both disciplines had an equal contribution in the business process management definition topic.

IV. CONCLUSION

We set out to identify the key contributions of the OM and IS disciplines to BPM. Our findings suggest that our knowledge of business processes and their improvement rests on the intertwined work of the OM and IS disciplines as neither discipline has comprehensively addressed each key BPM topics. While we have used a narrative review to provide a preliminary portrait of the OM and IS disciplines' contributions to BPM and to show that each discipline seems to focus on different BPM topics, we have yet to thoroughly assess the quality of the sources composing our narrative review. Future research could address this issue through citation analysis and/or expert discussions, which would provide a more objective assessment of each discipline's key contributions to BPM.

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