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STATE OF THE ART

The State of the Art of Business Process Management Research as Published in the BPM Conference

Recommendations for Progressing the Field

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Abstract The research field of Business Process Management (BPM) has gradually developed as a discipline situated within the computer, management and information systems sciences. Its evolution has been shaped by its own conference series, the BPM conference. Still, as with any other academic discipline, debates accrue and persist, which target the identity as well as the quality and maturity of the BPM field. In this paper, we contribute to the debate on the identity and progress of the BPM conference research community through an analysis of the BPM conference proceedings. We develop an understanding of signs of progress of research presented at this conference, where, how, and why papers in this conference have had an impact, and the most appropriate formats for disseminating influential research in this conference. Based on our findings from this analysis, we provide conclusions about the state of the conference series and develop a set of recommendations to further develop the conference community in terms of research maturity, methodological advance, quality, impact, and progression.

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1 Introduction

Over recent decades there has been a growing interest in Business Process Management (BPM), allegedly because of its allure to assist organizations in increasing productivity, achieving operational excellence or saving costs (van der Aalst 2013). Research in this field, which originated from work in computer science, management science and information systems (van der Aalst et al. 2003), has resulted in a plethora of models, methods and tools that support the design, enactment, management and analysis of business processes.

Many scholars argue that BPM has become a mature discipline (e.g., van der Aalst 2013), with its relevance acknowledged by practitioners and its scholarly impact respected by academics. However, scholars also challenge the BPM discipline, questioning whether the "research use cases" it pursues are comprehensive, original, and rigorous enough – or whether the research is indeed relevant at all (e.g., van der Aalst 2013; Recker 2014).

As with any other research, BPM research outcomes are disseminated in a variety of forums. BPM research has been published in the top, general-level journals of various fields, including information systems (e.g., Kettinger et al. 1997; Davenport and Beers 1995), computer science (e.g., Ouyang et al. 2009; Elzinga et al. 1995), or management science (e.g., Benner and Tushman 2003; Pentland 2003). There is also a journal focusing exclusively on BPM research, the Business Process Management Journal. Finally, over recent years, many of the premium

conferences in the research fields (e.g., ICIS, ECIS, and others) feature dedicated tracks on Business Process Management. In addition, the BPM discipline organizes its own annual conference series, The International Conference on BPM (http://www.bpm-conference.org), which commenced in 2003.

Our aim is to examine specifically the role of the BPM conference series in the development of the discipline and to provide empirical insights into the use cases of BPM research as evident in the papers published in the BPM conference proceedings between 2003 and 2014. We pursue this specific aim for five main reasons.

1. The BPM conference series is regarded as a leading forum for many researchers, practitioners, developers, and users in the field of BPM. Anecdotal evidence suggests that this is largely true for computer scientists and software engineering researchers; however, we must not neglect that there are also alternative venues for BPM researchers. For instance, almost all major Information Systems conferences feature dedicated BPM tracks, and many journals publish special issues on BPM research. The question begs: why submitting to the BPM conference?
2. A recent analysis (van der Aalst 2013) indicated that papers at the BPM conference are somewhat reductionistic in scope, often pursuing either popular problems (such as process modeling languages) or "exotic or even non-existing problems" (p. 29). The danger is therefore that the BPM community – as represented in the BPM conference – is not addressing persistent or important concerns and rather follows what others have dubbed research fads.
3. Observations have been made that the BPM conference has notably increased the reviewing demands such that papers purportedly require a novel idea, a rigorous formalization plus a systematic evaluation plus, where applicable, implementation of that idea. While this may be regarded as a sign of increasing maturity, it can also be lamented that fewer researchers will be able to satisfy these criteria, in turn diminishing the opportunities for early career researchers or doctoral students to enter an increasingly exclusive community.
4. We wish to extend the debate and analysis of use cases in BPM conference papers that was instigated by van der Aalst (2012, 2013). Our ensuing analysis will consider the use cases but relate this structuring of the conference papers with further details such as methodological approach, type of science pursued, research components and importantly scientific impact. In doing so, we will therefore complement the discussion in (van der Aalst 2013), which provided a typology of application domains of BPM, by providing a classification and review of "BPM *research* use cases" – how, where, and when BPM research is conducted.
5. As we will show below, there are multiple reviews available about published BPM research in general or some specific element thereof (e.g., empirical BPM research only). We provide an analysis that is specific in scope but broad in focus, which will complement existing reviews.

In completing this work, our ambition is to add to ongoing discussions about the state and progress of BPM research, by developing an understanding of current practices in publishing BPM papers specifically at the BPM conference, and setting the basis for future research practices at this particular conference and hopefully also beyond. We ask three retrospective research questions:

A. Is there evidence in the publication profile of the BPM conference that BPM research is maturing over time?
B. Which evidence is needed or presented at the BPM conference to sufficiently justify research in the different types of research conduct (e.g., formal versus empirical versus engineering research)?
C. Which BPM conference papers are arguably impacting the development of the discipline?

To offer generative advice based on the retrospective analysis, we add the following research questions based on the findings we develop in response to questions (A) to (C):

D. What can be methodological strategies to contribute to the development of research maturity and to positively influence ongoing development of research presented at the BPM conference?
E. Which general guidelines should be considered in the future of BPM research, at the BPM conference and beyond?

We proceed as follows. We will briefly review related analyses of the BPM field and other intellectual communities that have guided our research. Then we provide details on how our data collection and analysis was conducted. We then report on analysis of results and offer recommendations for further debate, before we reflect on our work in the context of the BPM use case discussion.

2 Related Work

2.1 The State of BPM as a Research Field

We are not the first to examine the identity, state, or evolution of BPM research. In fact, the work reported in this paper is only the logical continuation of several earlier viewpoints, commentaries and analyses on that topic.

One of the earliest articles to that end was the BPM survey as part of the first BPM conference in 2003 (van der Aalst et al. 2003). It provided an overview of the scientific and practical issues in the context of business process management systems at that time, with the aim to set an agenda for researchers to address the challenges in this domain.

At the tenth instance of the BPM conference in 2012, Wil van der Aalst provided an extensive analysis of "research use cases" as evident in BPM conference papers between 2003 and 2011 (van der Aalst 2012, 2013). His analysis identified popular research use cases such as design, enactment and verification of process models, and also – similar to our ambition in this paper – provided reflections for the future progress of the field and its conference series. In our paper, we now extend his analysis by widening the scope of the structure review to scientific, methodological, research and impact components. Through this analysis, we can provide further evidence in support of some of the key concerns; and importantly we can add substantive advice about research and methodological components in future BPM papers that should, in our view, contribute to advancing the field.

As part of the BPM conference series, especially keynote presentations have been used to discuss the state of the discipline. The BPM keynote in 2008 (Rosemann 2008), for instance, asked the question whether BPM research in the field is coined by rigor or relevance, and how the field could create more impact by combining rigor with relevance. Keynotes held by industry experts (e.g., Harmon 2008; Gilbert 2010), similarly, focused on the history and future of the BPM field – although many of these viewpoints are research agendas rather than analyses of the state of art of the academic field or the publications therein.

Outside of the BPM conference series, the state of BPM research has also been widely discussed. For example, several journal special issues were published that were designed to encourage particular types of BPM research, e.g., mixing engineering and management research on BPM (Dumas et al. 2012). Also, a variety of essays (Recker 2014), interviews (Kohlborn et al. 2014) and commentaries (Rosemann 2014) exist that portray proposals for progressing the state of BPM research. Notably, many of these articles describe ways in which BPM research could be made more diverse, inclusive, or innovative.

2.2 Related Publication Analyses

Our paper is related to a number of publication analyses. There is no point for us to recap all these works, therefore we will focus on reviewing four types of studies that have had an impact on the design, conduct or outcomes of the analysis reported in this paper.

First, the question of identity and diversity of an academic field is by no means new or restricted to subfields such as BPM. For example, in the Information Systems research discipline, publication analyses have focused on core artifacts (e.g., Nevo et al. 2009) and method diversity (e.g., Vessey et al. 2002). Literature reviews often focus on specific aspects of research disciplines such as the quality of empirical research methods (e.g., Basili 1996) or the state of research on particular phenomena such as culture (Leidner and Kayworth 2006) or outsourcing (Lacity et al. 2009), to name just two. In our ensuing analysis we pursue both a broad focus and a specific scope: we examine existent paper foci on artifacts and their development, and we also examine the maturity of research methods use, but our scope is restricted to BPM conference papers only.

Second, there are several studies that examine the nature and content of publications to make statements about the evolution of intellectual communities in general. These works also include analyses of publication and citations profiles of other academic conferences and outlets, such as ECIS (Galliers and Whitley 2007) or ICIS (Chan et al. 2006). The specific focus on conference proceedings is justified because they are important knowledge vehicles for research dissemination unconstrained by limitations of journal publications such as nature of contribution (innovative idea versus knowledge addition), time lag or quality and length expectations (Lisée et al. 2008). Our work adds to this emerging repository of conference profiles by examining specifically the profile of the BPM community as a discipline in its own right. Here, it is worth noting that the BPM conference proceedings were also subject to other types of literature analyses. Specifically, the 2007 edition of the conference was part of the data set in a study that examined the processes by which paper submissions to a conference end up as being accepted or rejected (Rosemann et al. 2010). In the case of the 2007 BPM conference, it was shown that originality and the technical soundness of a paper were the two significant factors impacting the acceptance/rejection decision (p. 295).

Third, some studies specifically examine the impact of academic contributions by examining citations of papers (e.g., Whitley and Galliers 2007). This is of some relevance to our ambition to understand the reasons about how and why some BPM conference papers have created impact – as measured in citations – to the field. We will return to this issue in Sect. 4.3.

Fourth, the literature also reports on literature reviews on BPM research in general or some specific focus of BPM research in particular.

Table 1 summarizes selected BPM literature reviews and positions our own analysis in the context of these studies. We also included an existing and widely cited 2-set volume of BPM research (vom Brocke and Rosemann

Table 1 Overviews of BPM research in the literature

Reference	Scope of review	Focus of review
Sidorova and Isik (2010)	Abstracts of journal articles in EBSCO database between 1927–2008	Broad: Themes in business process research
Houy et al. (2010)	Journal articles between 1991–2008	Specific: Empirical BPM research
vom Brocke and Rosemann (2010a, b)	None	Broad: snapshots of BPM research across six different dimensions
vom Brocke and Sinnl (2011)	Journal articles and conference papers until 2009	Specific: Research on culture in BPM
Niehaves and Plattfault (2011)	Journal articles and conference papers until 2009	Specific: Research on collaborative BPM
van der Aalst (2013)	Papers published in the BPM conference proceedings between 2003 and 2012	General: BPM research use cases
Our work	*Papers published in the BPM conference proceedings between 2003 and 2014*	*Broad: Multiple characteristics of BPM conference papers*

2010a, b) because these books provide very broad overviews of then-current BPM research without being a strict literature review. As opposed to most of the other reviews in Table 1, we have a specific rather than general scope but pursue a broad, multi-facetted rather than specific focus in our review.

3 Research Approach

There are two major approaches to literature analyses (Vessey et al. 2002). Classification studies use coding categories – for instance, for topic and research method – to separate published papers into meaningful groups. Citation studies examine references to cited articles in published papers. In our work, we performed both a classification study of BPM conference papers and an analysis of citation data for each of the papers.

Our review of the BPM conference papers drew on several established approaches (Paré et al. 2015; Rowe 2014; Vessey et al. 2002; Webster and Watson 2002). We proceeded in four steps: (a) extracting all papers from the conference proceedings, including keynote abstracts, (b) developing a coding scheme to categorize the literature, (c) analyzing the literature within each category (Vessey et al. 2002), and (d) extracting citation data for each paper using Google Scholar. The type of literature review we pursue is a form of comprehensive review that summarizes all relevant literature (Levy and Ellis 2006).

We extracted the entire collection of papers published at the BPM conferences between 2003 and 2014. This data set consists of 347 papers. To perform the analysis of the papers, we first created an Endnote database with the citation data as well as the full content of the papers. Next, we created a database in which each paper contained in the Endnote database was coded alongside several dimensions of interest.

We knew that coding these papers would largely be a qualitative, interpretive act rather than a count of quantitative information. Therefore, we followed established guidelines for qualitative coding; in particular the process prescribed by Hruschka et al. (2004). This process suggests iteratively developing a coding scheme, applying it to a randomly selected sample by at least two independent coders, and then conducting independent reviews of the entire dataset with sufficient reliability checks and a final reconciliation and merging. We applied this process as follows:

To develop a coding scheme, we started by analyzing other reviews that examined papers appearing in conference proceedings (Galliers and Whitley 2007; Chan et al. 2006; Stein et al. 2014) and perusing coding dimensions used in other literature reviews – for example, research approach (Vessey et al. 2002), research method (Chen and Hirschheim 2004), research topic (Galliers and Whitley 2007), and quality of empirical evidence (GRADE Working Group 2004). We added to these general categories dedicated new categories to codify the papers against criteria of BPM research that we had a specific interest in, such as type of inquiry (to distinguish inductive studies from meta-analyses or engineering-type papers, for example), research components (to identify whether the core emphasis of a paper was placed on an artifact, a theory or otherwise), or BPM lifecycle stage (to identify the type of BPM phenomena addressed in a paper).

Our coding scheme then evolved over three rounds of pilot tests. During each pilot test, the two authors coded a selection of randomly selected documents. We then reviewed our coding and focused on areas of inconsistency in our application of the codes we developed. We also reflected on the sufficiency of the coding scheme to meet the goals of our study. Thereby, we added several classifications that we required for the specific research

questions we set out to answer (e.g., BPM lifecycle, research components or type of inquiry). This pilot process also highlighted the importance of having code definitions and examples of their use to ensure coders would have a consistent understanding of the codes. After the third pilot test we were satisfied with the consistency of our coding and the ability of the codes to capture sufficient detail of the studies to allow us to address our goals. Appendix A (available online via http://www.springerlink.com) shows the final coding scheme. We now briefly describe the most relevant classification categories we report on in this paper:

Focus and intent We classified the papers in terms of goal (as stated by the authors), paper format (full, short, keynote paper), and broadly into type of inquiry (formal science, information systems engineering, scientific study, inductive study, meta analysis, industrial application). We constructed this category based on the common perspectives in the philosophy of science that distinguish formal and empirical science, deductive and inductive logic, as well as the discussion of cases (Gauch 2003). With this category, we are able to broadly classify papers into different forms of research independent from a particular method chosen to conduct the inquiry. Industrial application papers are those papers that report on descriptions of BPM in practice without providing any detail about research processes or research evaluation. These were excluded from our analysis because they are not traditional research papers.

Research components We coded papers in terms of artifact developed (if any), theory used (if any), and hypotheses (if any) and research variables specified (if any). We only coded papers if they explicitly mentioned these codes in their paper.

Research method We classified papers for existence of an explicit discussion of the type of method used, such as formal proofs, surveys, experiments, use cases, illustrations, simulations and others. We used the classification of Vessey et al. (2002). We added to this classification a new category, design science (Gregor and Hevner 2013; Hevner et al. 2004), if a paper was explicitly positioned as such. Multiple codes were possible to identify multi-method papers. For example, Lakshmanan et al. (2013) report on elements of design science, field experiment and focus group.

BPM lifecycle We coded if a paper's contribution was positioned within one of the typical BPM lifecycle phases (e.g., discovery or analysis or execution). We used the lifecycle model of a standard textbook (Dumas et al. 2013) because we felt that this would ensure a global level of common understanding. We note that other BPM lifecycle models exist (e.g., zur Muehlen and Rosemann 2004; Houy et al. 2011; Mendling 2008) that would result in a slightly different classification.

Empirical evidence Where applicable, we recorded type and sample size of evidence (e.g., fabricated or real-world data, student or practitioner samples) used in the paper to build an argument or evaluate a theory or artifact. These criteria are common when examining sampling issues (Compeau et al. 2012) or quality of evidence in research (GRADE Working Group 2004). We extended this by also codifying the type of quantitative analysis (descriptive or inferential, where applicable) and whether or not research materials (such as data, measures, prototypes, code) were made publicly available.

Implementation We coded whether papers reported on some engineering or formal artifact, whether a prototype was being presented, and if it was made available to others.

Impact To measure academic impact we followed usual practices (Chan et al. 2006; Grover et al. 2006; Harzing 2010) and extracted citation data for each published paper, using Google Scholar data. The data is current as of 28 May 2015.

On basis of this coding scheme, we analyzed and classified each of the 347 papers. To ensure validity and comprehensiveness, our analysis was conducted by reading and classifying the full text of every paper rather than only abstract, title, and keywords. To ensure independence of the coding, we hired a research assistant with an appropriate understanding of BPM research but without knowledge of the objectives and intent of the study to codify the papers. The coding process was performed in several steps:

1. The research assistant was trained on the use of the coding scheme through the provision of definitions and coding illustrations for each criterion.
2. The research assistant was then asked to code a random sample of 5 papers. Also, both authors independently coded the same papers. The three results were then jointly revised to ensure a shared understanding of the coding process. We repeated this process three times until all three coders (the research assistant and the two authors) reached a matching interpretation of all papers.
3. The research assistant independently coded all papers in the dataset between 2003 and 2013. To assist reliability checks, the assistant highlighted problems during coding in a separate column. Both authors independently reviewed the coding, and clarified and revised unclear codes where required. During the course of the paper revision, upon request from the reviewers, one of the authors then coded the conference papers from 2014, which were not available

initially. The research assistant was unavailable for this task.

4. Finally, the independently reviewed coding sets were combined and any remaining inconsistencies were removed through discussions, first, between the authors and the research assistant and then between the two authors of this study.

Through this process, we arrived at what we felt would be a sufficiently reliable shared interpretation of the papers. To enable transparency and to allow for further inspection and analysis of the prepared data for our analysis, the complete coding scheme and results are available for inspection by reviewers and readers at http://dx.doi.org/10.4225/09/5631562D12354.

4 Analysis and Results

The codification of the complete data sets as described above allow for a multitude of interesting analyses and correlations. In the sections that follow, we now examine the findings from these analyses in light of the questions we pose above. We will discuss each question, in turn.

4.1 What is the Publication Profile of the BPM Conference Series and What Can We Learn From this Profile?

Van der Aalst (2013) structured the domain of BPM research into twenty use cases, and perused this codification to analyze trends in papers presented at the BPM conference series.

In our first examination of the publication data, we now wish to examine the domain of BPM conference papers from a second, complementary angle: Business process management is often presented in terms of a lifecycle model. Although these lifecycle models are partially presented for didactic reasons, they still provide a balanced treatment of the different concerns of business process management. Table 2 utilizes the lifecycle model from Dumas et al. (2013) for categorizing papers of the BPM conference proceedings. Multiple categories could apply for a single paper.

We note in Table 2 an apparent imbalance of research in BPM conference papers on the different stages of BPM. Much of the work appears to relate to the process discovery stage – 56 % of all papers relate to this stage. The use case analysis by van der Aalst (2013) similarly notes an over-proportional emphasis on process models and modeling in the published papers to date. The stages that received the least coverage appear to be re-design (6 %) and monitoring (2 %). Re-design in this context is noteworthy, since it is an activity that requires an empirical research agenda as it can hardly ignore human involvement and organizational context. It also de-emphasizes analytics and instead includes elements of creativity and innovation. Monitoring, in contrast, requires efficient processing techniques, and ability for big data analytics. Both have in common that viable concepts have to be judged in terms of the utility they can provide for the organization, and both require access and systematic evaluation of empirical data.

Examining the data in Table 2 from a longitudinal perspective, we note two main findings. First, the above-mentioned emphasis on process discovery phenomena

Table 2 Number of papers by year and process lifecycle stages

Year	Process identification	Process discovery	Process analysis	Process re-design	Process implementation and execution	Process monitoring and controlling	Total
2003	5	15	6	1	2	0	26
2004	3	15	4	1	1	0	19
2005	5	30	7	5	5	0	41
2006	9	27	3	0	6	1	37
2007	4	21	7	0	8	1	30
2008	2	18	7	1	7	1	32
2009	6	14	5	0	5	0	23
2010	6	11	2	0	13	3	24
2011	7	10	4	3	19	0	30
2012	9	11	4	7	18	0	26
2013	2	7	7	3	18	0	28
2014	1	14	10	0	8	2	31
Sum	59	193	66	21	110	8	347
Share (%)	17	56	19	6	32	2	

appears to subside after an increase in the years 2003–2005. In contrast, BPM conference papers addressing process identification and implementation phenomena (e.g., through process mining technology and through data available from implementation systems) have been increasing since 2009. In fact, process implementation and execution papers have plateaued as the most prominent paper type between 2011 and 2013. In 2014, 24 of 31 papers concerned process discovery or analysis.

4.2 Are There Signs of Maturity in the BPM Conference, as Evidenced by Better Papers over Time?

The quality of papers has to be partially reflected from the eye of the beholder. We therefore focus in our evaluation of maturity on methodological aspects of the research process in BPM conference papers. That is, we examined whether papers explicitly discuss and address components of research designs typically associated with BPM research, such as design science and algorithm engineering, or empirical and theoretical research. To that end, we examined papers whether they explicitly discussed components of their research such as variables and hypotheses (for empirical research), or artifact and theory (for engineering and design papers). Table 3 summarizes the explicit discussion of research components from a methodological point of view, and Fig. 1 shows the relative share of BPM conference papers that explicitly discuss the above research components over time.

We note two main observations from the data summarized in Table 3 and visualized in Fig. 1. More specifically, we note that maturity in terms of methodological rigor appears to be a two-sided coin. First, we interpret the data in Table 3 as indicating that engineering papers that report on artifacts and formal concepts are traditionally well-represented at the BPM conference. This can also be seen by the high percentage of papers explicitly discussing engineering artifacts and formal concepts over time (see Fig. 1, which plots the relative share of papers in a given year that explicitly discuss research components).

Second, from the viewpoint of empirical and theoretical work, however, we note that there are only a handful of BPM conference papers explicitly developing hypotheses (12 out of 347 in total), and very few stating independent or dependent variables. From Fig. 1 we note that the share of papers with explicit discussion of theory or hypotheses is also not notably increasing over time. This is a concern, because one would expect that with increasing maturity of research that is presented at a conference, studies would increasingly evaluate and falsify theoretical predictions rather than explore empirical evidence without a priori expectations. This also indicates concerns about the possibility of retroduction as a means of scientific appraisal.

A second evaluation of the maturity of BPM conference papers can be done via appraisal of research methods. We interpreted methodological maturity as the explicit discussion of research methods in BPM conference papers. Table 4 summarizes the share of papers with explicit reference to established research methods. We note that formal proofs, design and engineering work, augmented and evaluated with partially simulated data, make up the largest share of BPM papers, as would have been expected. Formal proofs were included in 20.7 % of published papers. Simulated or fabricated data was included in 66.9 % of papers. We also note a large share of papers that report on analyses of illustrative scenarios (11.8 %) and case studies (18.4 %).

Next, Table 4 clearly identifies a lack of papers at the BPM conference using quantitative empirical research

Table 3 Number of papers with explicit discussion of research components by year

Year	Artifact	Formal concepts	Algorithm	Theory	Hypothesis	Ind. variables	Dep. variables
2003	15	12	1	8			
2004	18	11		5			
2005	35	16	9	5	1	1	1
2006	33	16	11	5			
2007	27	12	3	6	3	4	3
2008	23	6	5	5	2	1	1
2009	17	8	9	3	1	1	1
2010	20	6	5	3	1	1	1
2011	23	7	8	6			
2012	21	2	5	6			
2013	14	5	8	7			
2014	30	11	15	5	4	5	5
Total	276	112	79	64	12	13	12

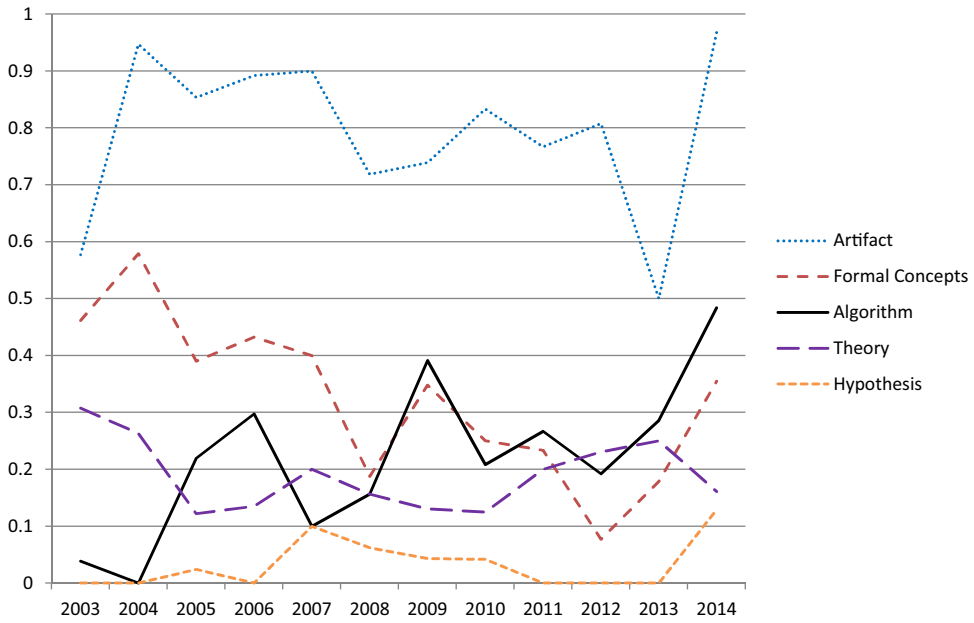

Fig. 1 Evolution of research components in BPM conference papers over time

Table 4 Number of papers with explicit discussion of research methods by year

Year	Formal proof	Field experiment	Controlled experiment	Survey	Case study	Interviews	Action research	Design science/ engineering	Simulation	Illustration	Other
2003	7		1		5			7	16	3	3
2004	6		1		7		1	2	16	2	1
2005	9	1	1		4	1		7	34	4	2
2006	9				6			8	33	2	2
2007	4	1		2	12	3		8	22	3	2
2008	5				6	1		5	24	7	1
2009	9	1			5			1	13	1	5
2010	6	2		2	6	1		5	14	1	
2011	6				4			4	21	2	1
2012	2				4			3	17	7	2
2013	4	4	1	2	2			4	8	6	2
2014	5		2	1	3			25	14	3	1
Total	72	9	6	7	64	6	1	79	232	41	22
Share (%)	20.7	2.6	1.7	2.0	18.4	1.7	0.3	22.8	66.9	11.8	6.3

methods that build on statistical evaluation such as experiments (4.3 %) and surveys (2.0 %). It is also striking to note that hardly any insights from interviews are reported at this conference. Also action research is hardly utilized. Together, this data signifies the absence of thorough empirical work at the BPM conference series that concerns BPM in actual industry practice. This is important to note especially given the wealth of empirical BPM research reported in other forums including journals (e.g., Jans et al. 2014; Rebuge and Ferreira 2012; Overhage et al. 2012), conferences (e.g., Bandara et al. 2006; Larsen and Myers 1997; Indulska et al. 2006) and even dedicated workshop series (Recker et al. 2011). Furthermore, the profile of the BPM conference proceedings is also in contrast to larger research disciplines building on empirical work such as management science, organization sciences or information systems – all of which arguably are reference disciplines to the field of BPM (van der Aalst 2013; van der Aalst et al. 2003; Dumas et al. 2013; Recker 2014; Grover and Markus 2008; vom Brocke and Rosemann 2010a, b).

We identify these observations as a cause of concern about the ongoing progression of the discipline as represented at the BPM conference. Empirical and especially quantitative studies of evidence are often noted as a gold

standard in research ("measure what can be measured, and make measurable what cannot be measured" by Galileo) because of the ability to systematically identify and qualify effect size, directionality or cause-effect relationships. We also see Table 4 as a quantification of the concern noted by van der Aalst (2013) that "real world evaluations" remain rather artificial and some research projects original but hypothetical rather than realistic or relevant (p. 29). We further note that in all relevant reference disciplines for BPM, such as management science, information systems and indeed design science and software engineering, are rigorous empirical appraisals the norm and by no means niche work or 'nice to have' features.

4.3 What Makes an Impactful BPM Conference Paper?

Aside from methodological maturity, we are also interested in identifying which BPM conference papers had an impact on the community. We discuss the impact of a contribution from the perspective of citations that a paper attracts. While it is possible that flawed papers stimulate a lot of corrective comments, it is generally believed that the number of citations capture the inspirational capacity and intellectual impact of a paper (Meho 2007). Of course, we are mindful that citations are only one measure of academic impact (Straub and Anderson 2010) and, importantly, do not necessarily reflect practical impact (Eysenbach 2011; Rosemann and Vessey 2008). Table 5 summarizes citations statistics of BPM conference papers per year collected via Google Scholar as of 28 May 2015.

Overall, we note that BPM conference papers attract arguably high levels of attention by other researchers, with papers published before 2010 on average being cited between 42 and 80 times. As expected, we also note a time lag of uptake for papers since 2010. Prior to 2010, in every year at least one paper rose to a status of a well-cited paper with at least 100 citations. Notably, the conference in 2007 included 8 such highly-cited papers.

Table 5 Citations statistics per year

Year	Citation statistics			No. of papers with citations		
	Mean	Std. dev.	Max	<10	≥10 <100	>100
2003	80.92	238.12	1239	4	20	2
2004	43.21	55.86	196	8	9	2
2005	49.49	82.91	388	11	25	5
2006	55.08	63.56	295	7	22	7
2007	78.80	87.25	327	5	17	8
2008	44.25	47.48	187	9	17	6
2009	42.26	45.86	213	2	20	1
2010	24.04	18.93	80	6	18	0
2011	21.87	21.52	94	11	19	0
2012	14.62	11.78	47	14	12	0
2013	9.64	6.30	26	16	12	0
2014	0.87	1.12	4	31	0	0
Total	39.35	84.40	1239	124	191	31

In the section above we observed an imbalance in terms of the number of contributions by a specific type of inquiry. Table 6 presents citations grouped according to inquiry type. It is interesting to note that papers that are based on formal science are cited as frequently as scientific studies such as experiments or surveys. Both attract more citations than inductive studies and engineering studies. It seems that despite the divide in maturity of using formal versus empirical methods, the latter seem to be very promising and apparently inspiring to large parts of the research community. There are a few meta analyses, with the survey paper from 2003 standing out with more than 1200 citations. Other meta analyses are not well cited.

We note that the data – as with other citation analyses – are skewed towards older papers. In the case of the BPM conference, we note a gap between papers prior to and after 2010 –likely because of the lack of time to impact the design, analysis and ultimate publication of a study.

We also note that formal science and scientific study papers have the largest proportion of papers with high impact, whilst meta-analysis and information systems engineering papers have the lowest proportion of papers with more than 100 citations.

Finally, one specific analysis we were interested in concerns the nature of the high-impact papers in the BPM conference. Table 7 summarizes the most cited papers in the conference series. For papers prior to 2010, Table 7 reports on the top five most cited papers overall, and between 2010 until 2014, it reports the most cited paper per year.

We note several observations when inspecting the codifications of the papers listed in Table 7. Of the papers prior to 2010, none has explicit research components (concepts, algorithm etc.) except for (Barros et al. 2005), which formalizes its concepts. Except for (van der Aalst et al. 2003), the papers deal largely with process discovery, and peruse simulation as evidence. Since 2010, the most cited papers all report on formal science or IS engineering, and notably include evaluations (Fahland and van der Aalst 2012; Senderovich et al. 2014) or the provision of the research materials and prototypes (Polyvyanyy et al. 2010).

5 Discussion and Recommendations

In what follows, we will first summarize our insights gained from the literature review, in accordance to the first three research questions we set out to answer. Then, to answer research question (D), we proceed to develop

Table 6 Average citations per type of inquiry and year

Year	Formal science	Inductive study	Information systems engineering	Meta-analysis	Scientific study	Average
2003	35.50	30.00	34.62	1239.00		80.92
2004	89.83	1.00	23.42			43.21
2005	65.54	3.50	44.36		61.00	49.49
2006	74.54		45.52	22.00		55.08
2007	113.75	71.11	55.30		87.00	78.80
2008	75.70	60.00	30.76	5.33		44.25
2009	58.00		28.00	39.33	22.00	42.26
2010	32.70	28.00	19.44	4.50	10.00	24.04
2011	35.64	5.00	11.25	6.00		21.87
2012	19.75	16.00	7.91	24.00		14.62
2013	11.22	6.25	10.07	3.00		9.64
2014	1.00	0.00	0.96	0.00	0.00	0.87
Total	51.51	35.22	26.68	96.20	50.57	39.35
Share of papers with <10 citations (%)	21	37	40	60	29	34
Share of papers with ≥10 and C 100 citations (%)	66	52	54	33	57	57
Share of papers with ≥100 citations (%)	13	11	6	7	14	9

Table 7 Most cited papers from the BPM conferences, before 2010 and after

Year	Reference	Citations	Goal	Type of inquiry
2003	van der Aalst et al. (2003)	1239	To demystify acronyms in the domain, describe state-of-the-art technology, and argue that BPM could benefit from formal methods/languages	Meta-analysis
2005	Barros et al. (2005)	388	To establish a reference for service interactions	Information systems engineering
2005	Hinz et al. (2005)	337	To present a Petri net semantics for BPEL4WS	Formal science
2007	Sadiq et al. (2007)	327	To propose an approach for the effective modeling of control objectives and their propagation onto business process models	Inductive study
2007	Günther and van der Aalst (2007)	306	To analyze problems of traditional mining algorithms with less-structured processes and derive a novel, more appropriate approach based on the map metaphor	Formal science
2010	Polyvyanyy et al. (2010)	80	To define a necessary and sufficient condition for an unstructured process model to have an equivalent structured model	Formal science
2011	Maggi et al. (2011)	94	To present a novel runtime verification framework based on linear temporal logic and colored automata	Formal science
2012	Ramezani et al. (2012)	47	To present a comprehensive compliance checking approach based on Petri- net patterns and alignments	Formal science
2013	Meyer et al. (2013)	26	To address the problem of modeling processes with complex data dependencies, e.g., m:n relationships, and their automatic enactment from process models	Information systems engineering
2014	Senderovich et al. (2014)	4	To mine service protocols of service providers from recorded event data and to present heuristics that originate in queueing theory	Information systems engineering

recommendations for the ongoing development of the research presented at the BPM conference. In doing so, we will structure the discussion of our recommendation into three scientific perspectives that we believe are relevant to our understanding of BPM research as represented at the BPM conference series. We discuss each of these viewpoints and its implications, in turn. Finally, we will offer a set of broader recommendations independent of these specific paradigms in response to our research question (E).

5.1 Summary of Insights

Table 8 provides a summary of our observations from our analysis.

5.2 Progressing BPM as a Formal Science

In examining how the BPM research as represented at the BPM conference series can progress, we note that BPM can be approached from various angles. In the BPM conference series, we observe a strong tradition of research that acknowledges BPM as formal science. The research objective of this line of inquiry is the identification and definition of formalisms that capture BPM-related phenomena and which can be judged according to having sound and interesting formal properties. The underlying epistemological assumption of this line can be related to positivism, in the sense that real-world phenomena and formal definitions can be objectively matched.

The results of our analysis suggest that BPM as a formal science is well-represented in the BPM conference series and that it is well-understood by its key contributors. This is, for instance, reflected in the extensive reference to formal Petri net concepts, algebraic definitions and utilization of formal logics in many papers. This line of inquiry is likely to be beneficial for analytical tasks at various stages of the BPM lifecycle. It also contributes to the establishment of sound process implementation. Overall, our assessment suggests that the BPM conference research community is mature in its application of formal sciences. In turn, we believe three avenues exist to capitalize on this maturity:

First, there is an opportunity by strengthening the role of the BPM conference series as a demonstration of methodological expertise. It is likely that other research fields concerned with processes are not as mature in formal sciences as the community present at this conference. In turn, this presents an opportunity to exert a role as thought leader and advisor. For example, process mining could potentially inform techniques in neighboring fields, such as process tracing (Tansey 2007), which is used in political sciences. Contributions could thus be in the form of methodological essays and guidelines that the BPM conference community could provide to other research fields.

A second opportunity exists in further formalizing and standardizing methodological criteria for formal sciences in BPM. A unified set of guidelines and assessments would contribute to harmonizing the field and easing the expectations of both authors and reviewers. One way forward, for instance, would be to have an explicit agreement on the type of tests used to study formal algorithms – much like the information retrieval community's effort to standardize tests and use cases for "picking winners" (Harman 1993).

Third, opportunities exist to complement mature formal research on BPM with other types of sciences (e.g., behavioral or design). Ideally, such efforts would involve multi-methodological teams that provide expertise in either of the two (or more) sciences. We see an increasing number of such mixed-method studies that show rigorous application of formal science and other sciences (e.g., Weidlich and Mendling

Table 8 Overall assessment of the literature review observations

Research question	Findings based on observations
Is there evidence in the publication profile of the BPM conference that BPM research is maturing over time?	The conference series has so far attracted an imbalanced portfolio of contributions, largely related to process documentation in the past and increasingly on process identification and implementation. Maturity in the sense of comprehensive coverage of BPM lifecycle phenomena is not evident, and especially contributions to process improvement remain absent
Which evidence is needed or presented at the BPM conference to sufficiently justify research in the different types of research conduct?	Maturity in the sense of methodological rigor is strong in some type of inquiry – notably formal sciences and engineering research. There is a noted absence of methodologically strong empirical and theoretical research. The conference proceedings are remarkably different from other empirical sciences in its composition of research methods
Which BPM conference papers are arguably impacting the development of the discipline?	Many BPM conference papers create significant impact. Overall, the spreading of citations is similar to other research communities and follows a power law distribution. Scientific studies and formal analysis papers have high citation averages. In recent years, formal science papers demonstrate most impact

2012; Rebuge and Ferreira 2012); but in absolute terms such contributions still remain few and far between (Recker 2014).

5.3 Progressing BPM as a Behavioral Science

BPM can also be approached as behavioral science. The research objective of this line of inquiry relates to the description and understanding of human and organizational behavior in the context of managing business processes and corresponding artifacts.

This line of inquiry often intersects with cognitive psychology and organizational science. It requires the investigation of what people perceive and believe, what they do, and why they act as they do. It is hardly accessible by formal proof, but rather requires empirical research methods like experiments, surveys, case studies, etc. It also requires a thorough understanding of social and cognitive theories, a careful definition of research hypotheses, and a diligent application of statistical methods.

Our analysis suggests that apparently, this line is less strongly represented at the BPM conference. To progress this line of research at this conference, we therefore suggest to more strongly leverage insights from neighboring fields that embrace empirical methods and theories, such as software engineering and information systems research. We offer four suggestions:

First, the discipline of software engineering has recognized the need for more empirical work already in the 1980s, most strongly inspired by works of Victor Basili (e.g., Basili 1984). Since then, this community has developed a systematic research agenda that investigates mainly how humans and organizations interact with software engineering artifacts. While correlational studies or pseudo experiments have been prominent in the beginning (Basili 2007), there is a growing uptake of experimental research. Most influential is the book on experimental software engineering by Wohlin et al. (2000). Standards for reporting experimental work in a research paper have been refined for instance in (Jedlitschka et al. 2008). Again, note that also in empirical software engineering, qualitative methods such as think-aloud protocols are utilized (Seaman 1999). The research line of BPM as a behavioral science should build upon these established and well-tested guidelines and modify them to provide a standard set of criteria and guidelines for empirical BPM research that can be submitted to and published at the conference.

Second, the field of information systems research can be a source of inspiration for how to conduct survey research, data validation and the precise measurement of behavioral and perceptual constructs relevant to artifact use (e.g., Straub et al. 2004). Some of these methods and instruments have already been adopted to the BPM field in general (e.g., Recker and Rosemann 2010; Schmiedel et al. 2014). More generally, respective standards are highly important for measuring BPM-related phenomena in a valid and reliable manner. Examples are still scarce both in general and at the BPM conference in particular, and we believe a wider update and, importantly, further contributions would be fertile for the conference as well as for the field in general.

Third, there is a growing awareness in information systems research of a need to generalize insights in the shape of theories (Weber 2012). This has stimulated the uptake of research methods for theory-building such as the grounded theory method (Strauss and Corbin 1998) or theory building from case study research (Eisenhardt 1989). Again, we see significant opportunities for increasing the maturity of BPM conference papers through (a) systematic and widespread adoption of existing guidelines for such research by drawing on works in most mature research disciplines and (b) contributing to the ongoing development of such guidelines.

Fourth, as a major step towards an incremental research process, both empirical software engineering and information systems research emphasize the need of systematically reviewing literature. Articles in both information systems (Webster and Watson 2002) and software engineering (Kitchenham et al. 2007) give detailed guidelines for transparent reporting. Literature reviews can be varied (Rowe 2014; Paré et al. 2015); but we believe that especially those types of literature reviews are required in BPM that assist the development of novel theory about processes and their management (Rivard 2014).

As a final point, we note that to date there seems to be a certain affinity of BPM conference papers of the behavioral science-type with process discovery and process redesign as both are organizationally situated tasks conducted by humans. Yet, we posit that organizational performance as related to process monitoring and organizational process implementation can also benefit from this perspective. For instance, process analytics and controlling studies could be conducted that examine how process analytics or process intelligence data is perceived by decision-maker and how these (lawful or unfaithful) perceptions influence decisions made about the processes.

5.4 Progressing BPM as a Design Science

BPM as a design science can be considered a third line of inquiry. It perceives BPM as an engineering discipline with the research objective of designing artifacts that provide superior utility in the context of managing business processes. Design science (Hevner and Chatterjee 2010; Hevner et al. 2004) is a relevant discipline, amongst others, within the global information systems community (Heinrich and Riedl 2013), for which the BPM conference research community has valuable tools at hand.

Design science requires the capabilities of researchers to design new algorithms and systems (which lends towards the more formal side), but it also requires empirical research methods to demonstrate superior utility (which is more on the behavioral side). Our assessment of the BPM conference papers to date showed that neither side appears to be very mature. We offer four suggestions to increase the maturity of design science papers at the BPM conference, in relation to taxonomies, stakeholders, case studies and algorithm engineering.

First, there appears to be a need for taxonomies to structure the field and the relevant artifacts. This would start with a definition of types of processes (Recker 2014, p. 11) but could expand to a typology of improvement approaches, management techniques or BPM systems. We also note a need to define harmonized and accepted typologies of important process metrics for process analysis, improvement as well as mining and controlling. On the one hand, such work could build on established taxonomies such as the ACM computing classification system (ACM 2012) and extend it where needed. On the other hand, it could draw on current debates about design science in general, such as those that examine forms of design science in the context of establishing reporting guidelines (e.g., Gregor and Hevner 2013).

Second, in the BPM conference papers, many of the engineered techniques in terms of design science seem to be implicitly tailored to support the process analyst. There are other roles and broader tasks that are hardly covered, for instance the process participant working in the process, the process owner supervising a process or indeed the process manager governing all other process roles. Also, the emphasis of the control flow perspective is overly strong. Research to differentiate process roles, tasks and perspectives can help to identify white spots, for instance based on a systematic literature review. The work on use cases (van der Aalst 2013) contributes to this need and can be extended to cover additional perspectives, roles and artifacts.

Third, BPM as a design science is often situated in a complex environment that is difficult to grasp with statistical research methods. We found that many BPM conference papers appear to acknowledge this fact implicitly by positioning their work as a case study, even though we found that many of these cases would more appropriately be designated as use cases, illustrations or simulations rather than scientific case studies. Similar to (van der Aalst 2013) we noted in our analysis that guidelines for the rigorous conduct and reporting of case studies are rarely considered. Researchers must be aware that case study research builds on detailed research protocols. In order to advance the field, references from software engineering (e.g., Runeson and Höst 2009) or information systems research (e.g., Klein and Myers 1999) should be used. Also action research (e.g., Baskerville and Wood-Harper 1998) is a promising research method for studying BPM-related phenomena, because of its evident focus on the implementation and study of change. There is ample and growing literature on the use of such methods for the evaluation of artifacts in design science projects (e.g., Tremblay et al. 2010; Venable et al. 2014; Mettler et al. 2014), and we posit that the BPM conference in this vein of research should adhere and contribute to these guidelines.

Fourth, we observe that a good share of BPM conference papers designs algorithms that are meant to provide efficient and effective solutions for BPM-related problems. Here, it must be noted that, beyond formal algorithm analysis, the engineering of algorithms also requires the explicit definition of hypotheses on which kind of benefits the algorithm is meant to provide (Sanders 2009), which we rarely found to be explicit in papers. This is related to the need to establish a research contribution, which in design science equates with a superior utility. This superior utility (e.g., better runtime performance, better precision and recall, comparable results with weaker assumptions) has to be made explicit in terms of evaluation hypotheses. In order to advance the design science papers at the BPM conference, it is desirable to make benchmark data publicly available (such as was done with the BPI challenges 2012, 2013 and 2014 or the process matching contest 2013). Furthermore, the progress of the field benefits from the public availability of prototypical implementations of algorithms (such as within ProM) as it stimulates comparison and incremental improvement. As above, we also note that the shared agreement on key test cases and test criteria could be beneficial, as is established in other research fields (Harman 1993).

5.5 General Observations for Progressing the Field at the Conference and Beyond

Finally, to answer research question (E), we would like to offer a broader set of five general recommendations for progressing BPM research at the conference and ideally beyond. These recommendations are not firmly vested in the analysis conducted to date but rather rely on our observations of general research practices in BPM as well as other fields. Still, we believe that the following five recommendations will contribute to establishing a more mature, rigorous and encompassing set of BPM research use cases in the future. Our five recommendations are as follow:

1. Increase the motivation for and joint work on benchmarks and the shared provision of open Sharing: data, research results and tools to allow for reproducibility,

further application, replication and verification of emerging research. Initiatives such as ProM already show the benefits of such an approach. As noted above, other fields actively encourage sharing of quality benchmarks (GRADE Working Group 2004), standardized tests (Harman 1993) or indeed data sets (http://www.opendataresearch.org); and it is increasingly obvious that these sharing principles contribute to the research productivity and quality of whole fields.

2. *Reporting* Establish reporting guidelines for BPM research work to harmonize the content and readability of BPM research papers. The BPM conference series could be an excellent trial platform for such guidelines. For instance, for BPM engineering papers the guidelines should minimally include (1) assumptions upon input, (2) explications of hypothesized benefits or utility (that is, affected dependent variables), (3) usage of appropriate benchmark data, and (4) provision of access to prototypes, code or other relevant materials. BPM behavioral science papers could adhere to reporting guidelines such as (1) baseline theory, (2) a priori hypotheses and propositions, (3) measurement and assessment of validity, (4) results and (5) discussion. BPM design science papers could draw upon reporting guidelines such as those offered by Gregor and Hevner (2013).
3. *Empirics* Promote the adoption and integration of empirical methods at the BPM conference series and in general, including the appropriate use of statistical methods into any form of BPM science; and adopt guidelines and benchmarks already existent in referent fields. An appropriate approach could be the inclusion of dedicated research method tutorials adjacent to the BPM conference. Coupled with points 1 and 2 above, our view is that neither data access nor research method can be regarded as boundary conditions – it is both feasible and purposeful to include faithful and valid datasets into research. We do recognize, however, that such a progression may involve changes to BPM paper submission requirements (e.g., length of paper or reviewing criteria).
4. *Perspectives* Promote and encourage work that expands our knowledge of BPM beyond the control flow perspective. Research on BPM data is increasing, but also the resource perspective is promising. Also the temporal perspective could be more intensively studied in order to further integrate BPM with operations management research and statistics. Beyond that, other context perspectives have not yet been deeply analyzed, such as social (Fischer 2011) and location-based contexts (Zhu et al. 2014). Congruently, more research work should be considered that integrates these varied perspectives into comprehensive and encompassing theories and solutions. Finally, expanding the perspectives on BPM research may also entail broadening the definition of BPM and processes to encompass research in other fields on other types of processes, such as software process improvement (Müller et al. 2010), scientific workflows (Davidson et al. 2007), organizational work routines (Pentland 2003) and others.
5. *Boundaries* The BPM conference community would benefit from a more explicit discussion of its boundaries, and in line with this, with an explicit consideration of what its fundamental assumptions are (Recker 2014). The call for papers for BPM 2015 is a good sign that BPM as a formal science, BPM as a behavioral science and BPM as a design science are equally embraced, and contributions to expand the scope of BPM research are welcomed. Still, to expand the boundaries of the conference series it is purposeful to first understand what the currently accepted scope is and which assumptions limit this scope. Over time, it would then be desirable to see a balanced share of contributions in all three scientific areas within BPM research as well as a balanced share of contributions on core and peripheral BPM topics, in order to advance the field of BPM at the conference, and as published elsewhere.

Finally, we note that we ourselves also wish to embrace our own recommendations. Therefore, in the interest of recommendations 1–3 above, and to facilitate a better discussion of points 4–5, we decided to openly share both the analyses reported and conducted as well as the dataset of papers and their codification on which our analysis was based, such that fellow colleagues can inspect our analyses and also conduct their own research on the dataset (http://dx.doi.org/10.4225/09/5631562D12354). We also hope that our conclusions and suggestions will stimulate a constructive and critical debate in the community with the view to identifying, trialing and implementing selected recommendations of ours as well as those of others.

6 Limitations

We are mindful of at least three main limitations of our study. First, the scope of our literature review was limited to papers published at the BPM conference. We did this deliberately to fit the call for papers in this special issue and to respond to the use cases by van der Aalst (2013). However, different research forums typically attract different types of paper submissions and are also viewed differently by different communities and authors. As one reviewer noted:

"Alternative BPM venues have a different perspective on BPM, publish papers which are methodically different from the papers published in the BPM conference proceedings and have different research goals."

We agree and thus caution the reader to be mindful of the boundaries of the conclusions and recommendations for BPM research that we offer – which are indeed targeted specifically at the BPM conference community.

Second, the BPM conference papers may be examined using different types of review strategies (Paré et al. 2015; Rowe 2014) and different objectives (Rivard 2014; Webster and Watson 2002. We chose a comprehensive review with broad, multi-facetted objectives. In turn, some detail of a more specific literature review on a particular objective may have been lost. However, as summarized in Table 1, this general focus also differentiates our literature review from related reviews that have more specific foci.

Third, our assessment of the BPM conference papers is inherently an interpretive inquiry in which we socially constructed our shared understanding of the papers and the type and quality of the research they describe. As such, our findings and implications are sensitive to multiple interpretations. They are also susceptible to subjective biases and distortions stemming from our own engagement with BPM research and the conference series over many years. In executing our study, therefore, we appropriated principles for interpretive research (Klein and Myers 1999). Specifically, we used principles of dialogical reasoning extensively in our joint discussions to establish a shared account of our understanding of the papers as well as their coding. Likewise, we used principles of suspicion to question each of our viewpoints and recommendations, in particular to tease out biases and distortions in constructing our recommendations for progressing the field in Sect. 5. Finally, we attempted to undertake a credible analysis. We did this by hiring an external researcher to complete the initial bulk of the coding, by iteratively reviewing and revising the coding until we arrived at an inter-subjectively agreed coding result, and most importantly by providing a detailed traceable, documented justification of our key coding concepts and definitions (Appendix A) and the coding process (Appendix B). We also share the final dataset upon which the interpretations and conclusions in this article are based. We invite commentaries and studies in response to our analyses and recommendations.

7 Conclusion

In this paper, we provided a discussion of BPM research as published in the BPM conference proceedings between 2003 and 2014. Our discussion focused on the retrospective analysis of research approach, methodological maturity and impact of BPM papers, and we generated a set of varied recommendations for progressing research published at the BPM conference.

Congruent to the theme of the special issue we now ask: How does our work relate to the BPM use case discussion (van der Aalst 2013)? We believe we have contributed in at least three ways:

First, we provided an alternative perspective on the set of BPM conference papers, that we believe complements and extends the analysis by providing a view on the "BPM research use cases". In particular, while the analysis by van der Aalst (2013) focused on "what" has been researched in the BPM conference research community, our analysis examined two complementary questions:

(a) "How": Through which research procedures has the research been conducted, and which artifacts and outcomes have been produced?
(b) "So what": What has been the impact of this research on the BPM conference research community?

Second, in doing so, we provide an empirical analysis of the published works from different angles that complements and extends the previous analysis.

Third, this analysis allowed us to provide a set of different recommendations: our recommendations relate to methodological elements of research conduct in BPM rather than the focused domain of BPM research.

In conclusion, we provided further input to the important discussion instigated by van der Aalst (2013) and we hope that the views offered in this paper will trigger both constructive debate and change in the research procedures of the community. Whilst our analysis and recommendations are tightly and explicitly coupled to BPM research as represented at the BPM conference series, we also hope that our views and advice will be of benefit to BPM researchers in general, independent from the type of outlet they choose for publication or the community they affiliate themselves with.

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