

Green Business Process Management – A Definition and Research Framework

Nicky Opitz
University of Göttingen
nopitz@uni-goettingen.de

Henning Krüp
University of Göttingen
hkruep@uni-goettingen.de

Lutz M. Kolbe
University of Göttingen
lkolbe@uni-goettingen.de

Abstract

The concepts of both business process management (BPM) and Green IS are on the agenda of IS researchers. BPM has a long-lasting legacy from enterprise resource planning and business process re-engineering. Green IS is still a young topic, although significant research progress has been made in recent years. However, in terms of combining the two aspects, there is still a lack of research. While there are some initial papers, concepts, and thoughts about this subject, a clear definition is missing. In this paper, we examine the literature concerning the research streams of Green IS and BPM and combine it with the initial research on Green BPM. Consequently, we present a definition for Green Business Process Management as well as a multidimensional framework for further research. We argue that research should focus on dimensions we could derive from literature in order to close the gaps in the field of Green BPM.

1. Introduction

Awareness of the negative environmental and social influences of modern information technology (IT) has become more prominent within the information systems (IS) research community during the last years. Researchers and the industry do have to come up with solution that meets the demands of a growing world population with limited natural input resources, while at the same time minimizing the output of emission and waste from technology. Building upon these issues, new IS research disciplines have emerged. Green IS and IT greening consider the role of IS in supporting sustainable business practices [48]. Green IT focuses on the reduction of consumption and emission of IT itself. Similarly, in the research discipline of business process management (BPM), substantial progress has

been made in terms of process orientation in enterprises. However, in terms of combining the two phenomena Green IS and BPM, there is a lack in research and practice. While there are plenty of cited papers, artifacts, and prototypes towards Green IS as an enabler for a greener business, most ideas have chosen a more functional approach. In particular, most projects deal with aspects of greening a department or business functions, such as green data centers, green office environments, or green logistics. A process-oriented approach towards a green business is still absent in both research and practice. To close this gap in research a new discipline has emerged which we will refer to as Green Business Process Management (Green BPM). With this paper we want to give readers a deeper understanding of the fundamentals of Green BPM. In particular, we answer the following research questions:

- What defines Green Business Process Management?
- Which fields of action exist and how can research gaps be closed?

To answer these questions, we will provide a general definition of Green BPM and specify a multidimensional research framework. This framework defines different gaps in the research field. It should help further researchers to provide solutions for closing these gaps in a sustainable way. There have been some prior literature reviews on the topic [31, 46]. However, these articles focus more on a generic Green IS dimension and do not provide a definition for the term. This paper is structured as follows: In the next section, we will present the fundamentals of Green IS and business process management, as well as provide insight into the field of Green BPM. Thereafter, we will explain our research concept and methodology, followed by a section demonstrating our findings. The research

questions are answered in the final section, along with some implications and ideas for further research.

2. Related research

In the following section, the fundamentals of process management and the green dimension of sustainability are discussed for the sake of legitimizing the research field. Furthermore, we offer insight into the research project from which this article originates.

2.1. Sustainability and Green IS

Within the research community and in corporate management sustainability is considered an essential concept [21]. The first and ongoing accepted definition was argued by the Brundtland commission as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" [51]. This definition is broad and somewhat imprecise, making it difficult for organizations to apply the concept in the business environment. Sustainability at the business level has emerged as a concept of long-term, simultaneous optimization of economic, environmental, and social objectives to generate lasting, superior financial business performance. Its three dimensions are not mutually exclusive and provide a framework according to which companies can measure and report their performances and organizational successes.

While organizations are still motivated to adopt sustainable business practices [41], the IS research community is encouraged to clarify the role of IS and IT in contributing to these efforts by using its transformative potential [4, 23, 45]. Results of this ongoing research are research streams such as Green IT, Green IS, and IT greening. Green IT is used as a generic term and multifaceted construct for measures and activities that aim to increase the energy efficiency of IT operations and enhance the sustainable use of material resources [3]. Murugesan [26], for example, relates Green IT to environmentally sustainable IT, defining it as "the study and practice of using computing resources efficiently". In line with Watson, Boudreau, and Chen [45], we argue that Green IT is too limited in its scope because it is restricted to the lifecycle of IT, whereas Green IS (which includes Green IT) encompasses all IS-based initiatives that support sustainable business practices. In addition the concept of IT greening exists, which encompasses the design, manufacture, use, and disposal of computers, servers,

and associated subsystems efficiently and effectively with minimal or no impact on the environment [23]. IT greening and Green IS have a broader perspective and are congruent in some points.

2.2. Business process management

Processes have been established as a central element of analysis in the planning, management, and control of tasks in enterprises and government. However, the process view focusing on the transformation of input factors into an output is never an independent view of activities [16]. Within the holistic approach of BPM, we focus on business processes, combining different perspectives and their artifacts—for example, a process, its assigned (IT) resources, and its integration into the organizational structure—to generate a feasible process performance [17].

In the past 20 years, the IS and BPM research communities have focused in particular on questions concerning the value addition of IT for the business [5, 22, 39, 40]. On the one hand, IT has been identified as a technological enabler of a specific business. On the other hand, IT supports processes, which has made it very difficult to measure the direct impact of IT [49]. In our new common understanding, Green IT and Green IS support a process change, which in turn enables a green business design [43]. As a result, it is not sufficient to introduce new Green IT and Green IS features; it is also important to adapt the old processes and other connected artifacts, e.g., the organizational structure [38]. An additional management task is to establish sensitivity and acceptance by employees through working with the newly developed green processes and their related systems [44].

For the management of business processes, there are a number of different process models, maturity models, languages, and graphical notations. De Bruin et al. [42] developed a maturity model to evaluate the ability of an organization to perform their process management. This maturity model uses the evaluation criteria: strategic alignment, governance, methods, technology, people, and culture. One of the most widely used languages that come with a graphical notation to represent processes is the Business Process Modeling Notation (BPMN) [32]. The main challenge lies in the integration of different concepts with a holistic approach for Green IT and Green IS that finally supports the management.

3. Methodology

3.1. Study design and scope

The main goal of this paper is to find a suitable definition for Green Business Process Management that is both comprehensive and tangible. To accomplish this goal, we have chosen to conduct a structured literature review following the principles of Webster & Watson [50] and applying the methods of Levy & Ellis [20]. In this section, we describe our scope and search strategy to ensure the adequate validity and reliability of our research.

The scope of a literature review can be defined by its research subject, time period covered, and publication outlets searched as boundaries [50]. Our research subject can be attributed to three different literature domains: Green BPM as the subject itself and its two legacy domains, Green IS and business process management. These were also our basic keywords.

As for the time period, we can argue that the boundaries for our literature research were determined by the age of their respective research domains. While business process management originated from the domains of total quality management and business process re-engineering in the 1980s, the holistic or life cycle management research started during the 1990s and is still a discussed topic. Green IS (and Green IT) first appeared on the research agenda in 2006/2007, but has lost some heat in recent years. The first article on Green BPM with a definite impact was published in 2009 [13].

Concerning publication outlets, it is preferable to mainly use high-quality journals or proceedings of major conferences. However, in a research domain that has only a very short legacy, such as Green BPM, this cannot be accomplished without omitting the majority of the research conducted thus far; there are hardly any articles on this topic in ranked journals and only a handful in major conferences. Within the discussion of rigor vs. relevance in the whole IS research domain, we argue that for examining a new research field, all relevant literature should be discussed without paying attention to only its rigor. The next subsection states which publication outlets have been used.

3.2. Search strategy

As we understand Green BPM not only as an IS issue, but also relevant to management, we have chosen two separate lists of ranked journals and

conferences for our initial search: the VHB rankings on “Business Information Systems and Information Management” with 78 entries and “International Management” with 26 [47]. The first ranking is mostly congruent with the current AIS journal ranking but also includes major conferences.

Our first keywords were ‘Green,’ ‘Sustainable,’ ‘Sustainability,’ ‘BPM,’ ‘Business Process Management,’ ‘BPR,’ and ‘Business Process Reengineering.’ As we were initially interested in articles containing ideas from both Green IS and BPM, we only applied combinations of the above keywords. However, as indicated in the former subsection, we found few articles using these keywords. This seems to be a rather common problem in Green IS research in general, as stated by Jenkin et al. [19] and Elliot & Binney [11].

From that point forward, we changed our approach and eliminated the limitation to high-quality journals and conferences. Instead, we searched through various public and proprietary databases (ScienceDirect, EBSCOhost, Google Scholar, ACM Digital Library) with the aforementioned keywords. We were able to find a number of articles that were on topic according to their title and abstract. With these articles as a foundation, we performed two iterations of author and reference forward and backward searches. Keyword forward and backward searches are also suggested by Levy & Ellis [20]. This method was dropped, however, as no further reasonable keywords could be derived. The second batch of literature was classified into three groups: general Green BPM, containing thoughts, concepts, or research gaps; high-quality Green IS literature, containing validated Green IS definitions and concepts; and high-quality BPM literature, containing validated BPM definitions, models, and concepts. With these three groups, we were hoping to achieve an appropriate balance between rigor and relevance for our definition of Green BPM. We started a third forward/backward iteration but at that point could not find further relevant articles on Green BPM. We argue that our current literature base covers the current state of the art. For a comprehensive view on our methodology, see Figure 1.

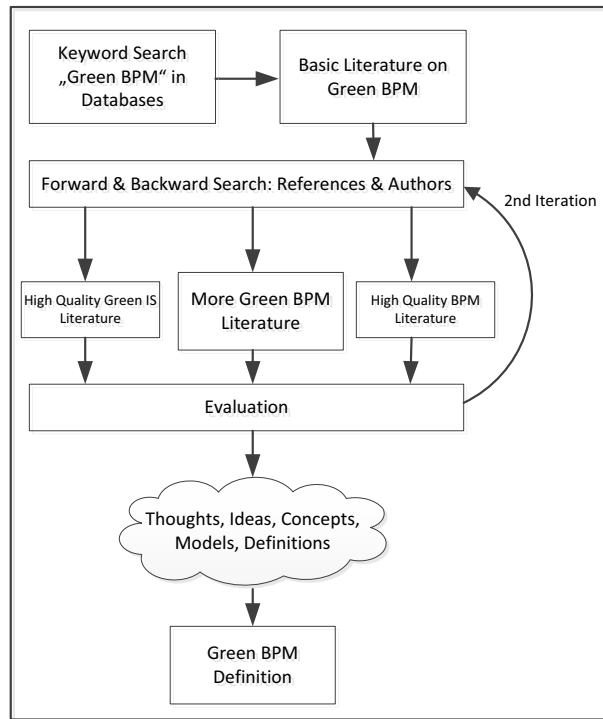


Figure 1. Conceptual research framework

4. Findings

4.1. Sample profile

Our initial keyword search in various databases returned 108 articles with a matching title. After examining the abstracts, 11 Green BPM articles were chosen for further investigation. They built the foundation for the author and reference forward and backward searches. After two rounds of forward and backward searches, we were able to retrieve a total of 26 articles on Green BPM, 21 high-rated articles on Green IS, and 9 high-rated articles on BPM, giving us a total of 56 articles to work with. We started a third iteration of forward and backward search, but noticed we could not find any further articles on Green BPM. Webster & Watson [50] stated: “You can gauge that your review is nearing completion when you are not finding new concepts in your article set,” so we finished our search at that point. We applied a deeper content analysis on the 56 articles we found, looking for definitions, thoughts, concepts, and models for Green IS and BPM in general and Green BPM in particular. 24 articles contained such artifacts and build the foundation of the definition we propose in the next subsection.

4.2. Finding a definition

Based on the literature, we classified the most important and suitable papers to arrive at a definition. Therefore, we started to focus our research on often-mentioned elements in the literature of Green IS and BPM as well as the few papers concerning Green BPM.

Therefore, we focused on sentences such as “Green IS,” on the other hand, refers to the development and use of information systems to support or enable environmental sustainability” [19] or “Green IT is part of a fundamental change in the economy and society. It is a subset of the larger green (sustainable) business trend, which reconciles sustainable business practices with profitable business operations.” [28] in order to find different keywords for the same goal. In the case above, it is obvious to define the word ‘environmental’ as a basic factor for the evaluation of the content of the papers for Green IT/IS. For other subclasses that we aimed to define, it was more complex. To find the papers for the subclass ‘monitoring,’ there were different keywords in the sentences, ranging from conspicuous ones in the case of Butler [1], who wrote, “Green IT programmes if their activities, processes and products are being monitored and reported,” to sentences that convey a similar meaning by describing it as “the ability of ICT to measure and optimise energy consumption which appears to offer the greatest benefits” [35]. In this case, we expect monitoring is needed to see the results and benefits gained by the change. Accordingly, we added this paper to the subclass of monitoring. By going through all the papers, we created a list with keywords to determine our subclasses.

From this list of findings we found keywords that included ‘environmental,’ ‘business process,’ ‘measure,’ and ‘evaluate.’ These keywords were abstracted to our sub-classes. The top classes are defined by the literature analysis based on the topic ‘Green IS,’ ‘Green IT,’ ‘BPM,’ and ‘Green BPM.’ Regarding the findings in our literature review and the classification, we set up Table 1.

Based on the content of each paper and the validation of our categories, we found that there is not yet a generally accepted definition of Green Business Process Management. The major focus on Green IS and BPM in the IS community led us to propose the following definition for Green BPM:

“From an IS researcher’s perspective, Green BPM is the sum of all IS-supported management activities that help to monitor and reduce the environmental impact of business processes in their design, improvement, implementation or operation stages, as well as lead to cultural change within the process life cycle.”

4.3. Research framework

Our second research question concerned possible fields for further Green BPM research. From the developed definition in section 4.2, we can identify three dimensions (see

Table 1, Classifying literature

Literature	Green IT/IS		BPM		Green BPM	
	Reduce Environmental Impact	Monitoring	Economical	Cultural Change	Reduce Environmental Impact	Definition
Boudreau et. al. (2008)	x	x	x			x
Butler (2010)	x	x				
Butler and McGovern (2008)	x				x	
Chen et. al. (2009)	x	x				
Cleven et. al. (2010)	x	x	x		x	
Daly and Butler (2009)	x					
Elliot (2007)	x	x				x
Gartner (2008)	x		x			x
Ghose et. al. (2009)					x	x
Hailemariam and van Brocke (2010)			x			
Houy et. al. (2010)	x	x	x		x	
Hoesch-Klohe et. al. (2010)					x	
Jenkin et al. (2009)	x	x				
Marrone et. al. (2011)	x	x				
Molla (2009)	x	x				x
Molla et. al. (2009)	x					x
Mines (2008)	x		x	x		x
Novak et. al. (2011)	x		x		x	
Ozturk et. al. (2011)	x					x
Pernici et. al. (2011)	x	x				
Recker et. al. (2010)	x	x	x		x	
Röglinger et. al. (2012)			x			
Rosemann and de Bruin (2005)			x	x		
Seidel and Recker (2012)	x				x	x
Seidel et. al. (2011)	x	x	x		x	
vom Brocke et. al. (2011)			x	x		
Watson et. al. (2010)	x	x				x
Research Contribution	x	x	x	x	x	

Figure 2). Dimension one contains management activities, such as planning, doing, controlling/checking, and acting. It is based on the four phases of the Deming Cycle [9], ‘Plan,’ ‘Do,’ ‘Check,’ and ‘Act.’ Dimension two contains all stages from the process lifecycle: design, measure/monitor, improve/change, and operate. Dimension three contains the identified goals of Green BPM: reducing the environmental impact and helping with cultural change within the process chain.

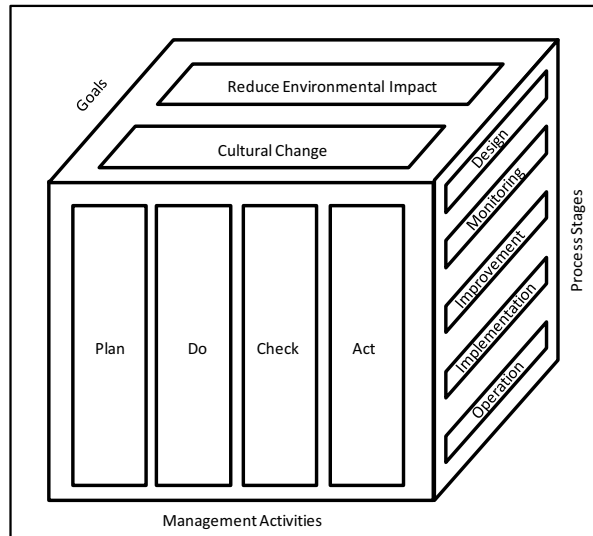


Figure 2. Green BPM research framework

We recommend further research to focus on combinations of parts of this framework to provide better solution in the respective fields. To give our readers an idea on how to combine these three dimensions into actual research we present four sustainability projects our university is currently working on and the corresponding framework classes:

Project: Green IT Cockpit – prototype development
Description: The goal of this project is the development of a business process oriented management cockpit tool for monitoring and managing the energy efficiency of IT resources in corporations.
Goal(s): Reduce environmental impact (of IT)
Process stages: Monitoring, improvement
Supported management activities: Check, act (IT management)

Project: eBikes for Commuting Purposes – acceptance study

Description: The goal of this project is to assess the requirements users of Pedelects or eBikes impose on the infrastructure. In this context, a corresponding improvement of the used infrastructure could increase the acceptance of Pedelects considerably.

Goal(s): Cultural change

Process stages: All

Supported management activities: Plan, do (infrastructure planning)

Project: EdiMed – health care process improvement
Description: The joint project “EDiMed - efficiency evaluation of service configurations in telemedicine” creates a tool through intense examination of telemedicine services. This tool evaluates those services in terms of productivity. This is intended to improve the medial care processes which are made possible by telemedicine. Particular emphasis will be put on the interplay of (partial) automation through IT enabled services and the integration of patients.

Goal(s): Reduce environmental impact (of health care)

Process stages: Improvement, implementation

Supported management activities: Do, check, act (medical staff)

Project: ResEff – resource efficiency gain

Description: The project "Resource Efficiency in Inter-Organizational Networks" focuses on the efficient utilization of renewable resources in combined production processes with multiple outputs. The ultimate goal is the cascaded utilization of renewable resources through multiple sequential utilization of the same input and prior to energetic utilization. The aspiration of efficiency aims is seen as a contribution to sustainability management by changing the course of action in all areas of the network.

Goal(s): Reduce Environmental Impact of production (using less resources)

Process stages: All

Supported management activities: All

5. Conclusion

From the results in the former sections, it can be concluded that, with certain limitations, Green BPM is an extremely relevant topic, with a high publication number within the past three years. While initial thoughts and concepts have been developed, a clear definition of the term was missing from the IS literature.

Our initial research question, “What defines Green Business Process Management?” can be answered as follows: Based on our structured

literature review, we assert that, from an IS researcher's perspective, Green BPM is the sum of all IS-supported management activities that help to monitor and reduce the environmental impact of business processes in their design, improvement, implementation, or operation stages, as well as lead to cultural change within the process life cycle.

Our second research question was "Which fields of action exist and how can research gaps be closed?" For this matter, we were able to identify three dimensions from the body of literature: management activities, process stages, and Green BPM goals. We argue that research should focus on one of these three dimensions or certain aspects of the relationship them. Until now, most of the research conducted has been in the area of the process monitoring/measurement stage with the goal of emission detection or reduction [33, 37].

There are some limitations in our preliminary findings. First of all, there were a handful of articles we could not obtain, as there was no full text version available from the databases we have access to. However, these were not articles that we would estimate as crucial for our research. The second limitation concerns the perspective of our definition. As we are IS researchers, we have an IS perspective on Green BPM, which also influences the way we define it. There could be scenarios in which environmentally sustainable process change is enforced or supported by management without the help of information systems or information technology.

There are some implications for research in our findings. Research in the area of Green IS or BPM should identify research gaps within the dimensions given by our definition of Green BPM. Our literature review demonstrated that, while there is plenty of qualitative literature published, most articles contain informal concepts or ideas. Researchers should focus on describing the current state within enterprises or designing methods, tools, or other artifacts for actually accomplishing the goals of Green BPM.

Our research contributes to the body of knowledge, as our definition can be seen as a foundation of the Green BPM research stream. With our Green BPM research framework, we provide a starting point for fellow researchers to find and define gaps in the current state of the domain. Nevertheless, further research is necessary. In a further step, we must validate our definition and research framework by delving even deeper into the literature and asking experts from theory and practice whether the framework needs refining.

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