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Faculty of Business Economics

Master of Management

Master's thesis

Investigating the Role of Business Process Management in Achieving Sustainable Development Goals in Organizations

Ha Trang Nguyen

Thesis presented in fulfillment of the requirements for the degree of Master of Management, specialization Data Science

SUPERVISOR :
Prof. dr. Mieke JANS

MENTOR :
De heer Shameer Kumar PRADHAN

2023
2024

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www.uhasselt.be
Universiteit Hasselt
Campus Hasselt:
Martelarenlaan 42 | 3500 Hasselt
Campus Diepenbeek:
Agoralaan Gebouw D | 3590 Diepenbeek

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ABSTRACT

The increasing focus on Sustainable Development (SD) and the 17 Sustainable Development Goals (SDGs) has prompted organizations to seek ways to incorporate sustainability into their operations. Business Process Management (BPM) is a discipline that assists organizations in managing and improving their processes, and it can play a crucial role in accomplishing the 17 SDGs. This study utilizes the systematic literature review (SLR) method to examine the role of BPM in advancing the 17 SDGs in particular and SD in general. The study identifies the specific SDGs that have been the focus of BPM research and explores how sustainability is integrated into the BPM lifecycle. The findings indicate that while BPM has the potential to contribute to all 17 SDGs, the main emphasis is on economic sustainability. The study also highlights various methods and techniques used throughout different stages of the BPM lifecycle, contributing to the development of a catalog that compiles the latest sustainability-focused BPM approaches for achieving SDGs. The SLR and the proposed catalog can serve as references for future attempts to apply BPM to drive SDGs by researchers and practitioners.

1. INTRODUCTION

Sustainable Development (SD), which focuses on satisfying current needs without sacrificing the ability to meet future needs (Brundtland, 1987), has become one of the central objectives of organizations nowadays (Loos et al., 2011; Butler, 2011; Seidel et al., 2017). This trend is driven by evolving customer preferences for ecologically friendly products, obligations to comply with sustainability regulations, and concerns about the unsustainable speed of resource consumption (Magdaleno et al., 2016; Munsamy et al., 2019; Schoormann et al., 2019; Yanamandra et al., 2023). SD is divided into three broad sustainability pillars: social, economic, and environmental (Elkington, 1997). To establish a global understanding of SD, The United Nations (UN) has characterized this concept in greater detail by defining 17 Sustainable Development Goals (SDGs) in its 2030 Agenda, a roadmap for tackling worldwide sustainability challenges (United Nations, 2015). Many organizations have committed to these SDGs and embraced them as key targets (Pedersen, 2018; Heras-Saizarbitoria et al., 2022). With this increasing focus on SDGs, Business Process Management (BPM), a discipline that assists organizations in obtaining their objectives by managing and improving processes (Dumas et al., 2018; Weske, 2019), can be used to support the achievement of SDGs.

For an organization to transition towards SD and reach SDGs by adopting BPM, it needs to embed three pillars of sustainability - environmental, economic, and social - into the BPM lifecycle (Magdaleno et al., 2016). The BPM lifecycle is a straightforward interpretation of how BPM is implemented and how each organizational process is managed (Rodríguez et al., 2021). Incorporating sustainability factors into the BPM lifecycle facilitates a holistic approach to achieving SDGs, helping organizations accomplish social and environmental targets while ensuring profitability (Watson et al., 2010; Loos et al., 2011).

Many studies have provided an overview of the use of BPM in achieving SD across three broad pillars: economic sustainability, environmental sustainability, and social sustainability (e.g., Couckuyt & Van Looy, 2019a, 2019b; Fritsch et al., 2022; Gohar & Indulska, 2020; Graves et al., 2023; Hernández González et al., 2019; Maciel, 2017; Schoormann et al., 2017, 2019). However, none of the existing reviews has studied the application of BPM to attaining the 17 SDGs in particular. This lack indicates a potentially missed opportunity to understand BPM's contribution to completing SDGs and the United Nations' 2030 Agenda, and the state-of-the-art BPM could have been overlooked in addressing global sustainability challenges. Therefore, there is a need for an overall view of BPM's role in accomplishing SDGs.

Aiming to provide a deeper understanding of the current state of BPM research in advancing SDGs in particular and SD in general, this study employs the systematic literature review (SLR) method. The expected contributions of this study are the revelation of which SDGs are focused in BPM research efforts and how sustainability is integrated into the BPM lifecycle to achieve the SDGs.

This paper is structured as follows. Section 2 provides the background of Business Process Management (BPM), Sustainable Development (SD), and Sustainable Development Goals (SDGs) and acknowledges the existing works related to this topic. The methodology to conduct a systematic literature review is demonstrated in Section 3. The results are detailed in Section 4, and the discussion is presented in Section 5. Finally, the paper is concluded in Section 6.

2. BACKGROUND

This background section concerns the definitions and attributes of different concepts discussed in this study. First, it introduces business process and Business Process Management (BPM). Second, this section delves into the concept of Sustainable Development (SD) and Sustainable Development Goals (SDGs) announced by the United Nations (UN). Subsequently, the section explores the connection established between BPM and SD in scientific research to develop a sound understanding of their relationship. Finally, a review of related works is presented to provide context for the current research within the existing body of knowledge and to identify potential gaps that this study aspires to address.

2.1. BUSINESS PROCESS MANAGEMENT (BPM)

A business process is defined as a combination of interconnected occurrences, activities, and decision points involving various participants and resources, jointly generating an outcome valuable to at least one party (Dumas et al., 2018). Therefore, business processes are considered one of the organization's critical assets (Nowak et al., 2012). The existence of business processes requires the presence of Business Process Management (BPM). According to Dumas et al. (2018), BPM implies a management approach that encompasses techniques, methods, and means used for process optimization. This discipline involves identifying, discovering, analyzing, redesigning, implementing, and monitoring business processes to enhance their performance (Dumas et al., 2018).

To measure the effectiveness and efficiency of BPM efforts, companies rely on process performance metrics. The typical measures are cost, time, quality, and flexibility, which indicate whether a process is functioning well or requires improvement (Dumas et al., 2018). How BPM is performed is presented by the BPM lifecycle (Rodríguez et al., 2021). While specific steps and descriptive terminologies of BPM lifecycle models may vary (e.g., Van Der Aalst, 2003; Rosemann & vom Brocke, 2010; Dumas et al., 2018; Weske, 2019), they share a common cyclical form, which means that business processes are continually evaluated and improved (Dumas et al., 2018). The BPM lifecycle model discussed in this study is derived from the work of Dumas et al. (2018), which provides a structured presentation of how BPM is conducted step by step and allows for a thorough investigation of how each lifecycle phase can contribute to the achievement of SDGs. This BPM lifecycle instance contains six stages. The initial phase is called Process Identification, where a business problem is demonstrated, and relevant processes are identified. This phase delimits the process scope and defines the process relationships, leading to an update of the existing process architecture or a new one introduced. The output of this step leads to the second stage, which is called Process Discovery, also known as as-is process modeling. Information is collected, and the present state of every process specified is translated into documentation, facilitating effective communication among the parties involved. Process Analysis step follows and detects the existing problems of the as-is process. A systematic gathering of weaknesses resulting from this phase is documented, and the issues are ranked according to their risks. Based on the information acquired from the previous stage, the process is then redesigned, aiming to address the potential difficulties and reach performance goals simultaneously. New adjustments are suggested in this stage, and the stage is named Process Redesign or Process Improvement. The next step is Process Implementation. The revised and remodeled process is executed, and the as-is process becomes the to-be process. This phase includes two dimensions: organizational change management and process automation. The last step to complete the cycle is Process Monitoring, which compiles and analyzes data from the improved process to ensure it performs as expected. The potential issues that may consequently lead to the degradation of the process are also investigated in this stage, and remedies are carried out. The output of the monitoring phase becomes the input for the discovery, analysis, and redesign steps, making the BPM lifecycle a continuous series (Dumas et al., 2018). The phases of this cycle are logically connected but not strictly sequential, and they allow redesign and development activities to happen during each step (Weske, 2019), leading to continuous improvement of business processes.

2.2. SUSTAINABLE DEVELOPMENT (SD) & SUSTAINABLE DEVELOPMENT GOALS (SDGs)

Sustainable Development (SD) has gained more attention due to the fact that the world has been consuming resources at an unsustainable rate, equivalent to 1.6 Earths, to meet the needs of humans (Schoormann et al., 2019). Additionally, customer behavior is shifting towards selecting environmentally friendly products, and companies are now required to comply with sustainability-related restrictions in order to operate (Magdaleno et al., 2016; Munsamy et al., 2019; Yanamandra et al., 2023). Following the most widely cited definition coined by the Brundtland Commission (1987), SD is "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland, 1987). A popular concept called the

Triple Bottom Line (TBL) created by Elkington (1997) divided SD into three dimensions: economic, ecological, and social. According to Larsch et al. (2017), environmental sustainability is achievable through reduced consumption and increased recycling. Social sustainability can be obtained by improving healthiness, safety, equality, and fairness, while economic sustainability is maintained by enhancing competitive advantages without negatively affecting the other two dimensions (Piotrowicz, 2011; Larsch et al., 2017). Due to the increased concerns about sustainability, many firms are transitioning towards SD (Loos et al., 2011; Butler, 2011; Seidel et al., 2017). They see this shift as an opportunity to solve sustainability challenges while productivity and profitability are still enhanced (Watson et al., 2010; Loos et al., 2011).

International organizations have made an effort to define SD to enhance a mutual understanding of the concept universally. Notably, the United Nations (2015) introduced the 17 Sustainable Development Goals (SDGs) in its 2030 Agenda, which is a comprehensive action plan for three SD dimensions: social, economic, and environmental. The SDGs consist of 17 goals to address a myriad of global sustainability challenges, which officially came into force on 1 January 2016. The goals encourage organizations to maintain a dynamic business landscape while guaranteeing that social rights and environmental health are met in compliance with global agreements and standards (United Nations, 2015).

The 2030 Agenda highlighted the interconnected nature of 17 goals, acknowledging that the achievement of one can impact those of others (United Nations, 2015). To present this interrelationship and connect the 17 SDGs with the three SD pillars (social, economic, and environmental), Rockström & Sukhdev (2016) proposed the Wedding Cake model, which has been referenced in numerous studies (e.g., Folke et al., 2016; Bergman et al., 2018; Pengue et al., 2018; Szennay et al., 2019; Block, 2020; Blix & Myhr, 2022; Barta et al., 2023; Greenland et al., 2023; Mangukiya & Sklarew, 2023). This model is chosen for the study because it assigns each SDG to only one sustainability dimension without creating overlaps, enabling the work to clearly reveal the varying levels of focus each pillar receives in BPM literature. Figure 1 illustrates the Wedding Cake model (Rockström & Sukhdev, 2016).

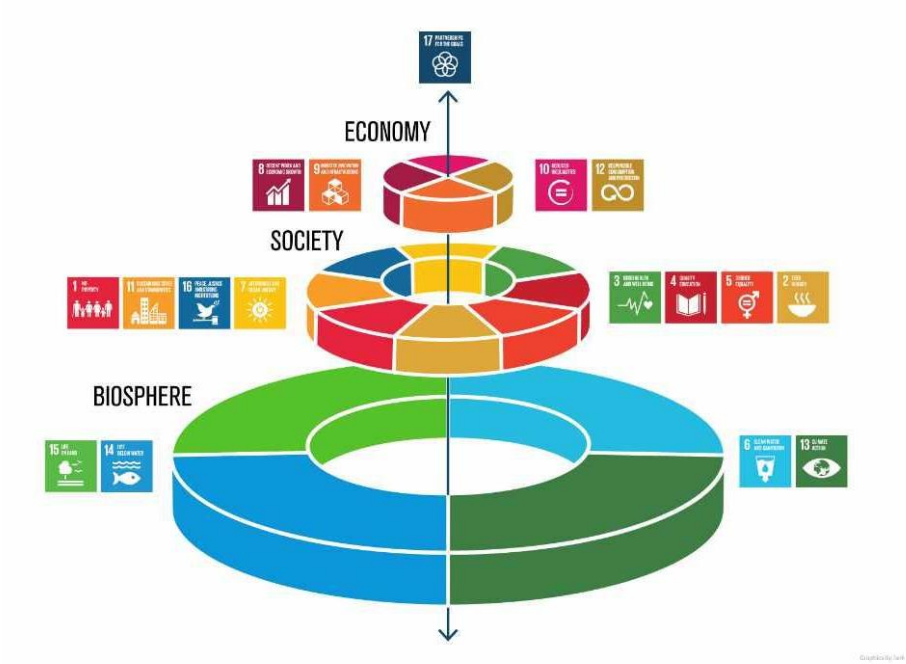

Fig. 1 The Wedding Cake model (Rockström & Sukhdev, 2016)

As portrayed in Figure 1, the base tier of the Wedding Cake model is the biosphere containing ecological goals such as preserving clean water (SDG 6), limiting climate change (SDG 13), and maintaining life in water (SDG 14) and life on land (SDG 15). The middle layer portrays society, including goals that ensure good health (SDG 3), quality education (SDG 4), clean energy (SDG 7), sustainable communities (SDG 11), and peace (SDG 16) while ending poverty (SDG 1), hunger (SDG 2), and gender inequality (SDG 5). The top layer depicts the economy, with goals focused on economic development (SDG 8), innovation (SDG 9), country equality (SDG 10), and responsible production and consumption (SDG 12). The detail descriptions of the 17 SDGs are provided in the Appendix. Remarkably, collaboration for achieving the goals (SDG 17) is not categorized and stays at the peak because of its universal cooperation characteristic. The model illustrates how the three separate parts intersect and how the 17 goals are interconnected, suggesting that all elements compose a complete SD system. In other words, the economic and social dimensions are regarded as integral parts of the environmental dimension. This integrated nature has also been emphasized by several authors, highlighting the indivisibility (Barbier & Burgess, 2017; Pengue et al., 2018; Block, 2020).

2.3. THE CONNECTION BETWEEN BUSINESS PROCESS MANAGEMENT (BPM) AND SUSTAINABLE DEVELOPMENT (SD)

In order to promote SD through BPM, it is vital to recognize sustainability as a crucial dimension alongside the four classical BPM metrics (Loos et al., 2011; Seidel et al., 2012). Additionally, sustainability must be integrated into each stage of the BPM lifecycle (Magdaleno et al., 2016).

Traditionally, BPM primarily focused on four factors, including time, cost, flexibility, and quality (Dumas et al., 2018); they were only concerned with the economic sustainability pillar (Loos et al., 2011; Seidel et al., 2012; Fritsch et al., 2022). The conventional and narrow concentration of BPM has restricted organizations from fully complying with the Triple Bottom Line (Elkington, 1997) and tackling the environmental and societal facets of SD (Schoormann et al., 2019). Additional considerations of sustainability have resulted in the emergence of Sustainable BPM and Green BPM. On one hand, Sustainable BPM considers all three sustainability pillars (economic, social, and environmental) and involves continuously refining, measuring, and optimizing processes (Rozman & Riel, 2015). On the other hand, Green BPM is dedicated to environmental sustainability and is perceived as an intersection between Green Information Systems (Green IS), allowed through process change and process-centric practices, creating environmentally sustainable organizations (Seidel et al., 2011). In a later work, these authors further characterized Green BPM by emphasizing its association with understanding, documenting, modeling, analyzing, simulating, executing, and continuously changing business processes with considerable dedication to environmental matters (Seidel et al., 2012).

In addition to considering sustainability as a BPM metric, sustainability must be incorporated into the BPM lifecycle (Magdaleno et al., 2016). An example of this integration is Maciel's proposal for the Green BPM lifecycle (Maciel, 2017), which focuses solely on environmental sustainability. This proposed lifecycle is presented in Figure 2. The author adapted the traditional BPM lifecycle model (Dumas et al., 2018) and explicitly added green practices in each phase, demonstrating the effort of BPM in driving environmental sustainability initiatives within organizations. Both the classical BPM lifecycle and the Green BPM lifecycle share an identical circular structure and fundamental stages. However, several differences can be noticed between the two. In Process Identification phase, the Green BPM lifecycle additionally acknowledges sustainability goals with the definition of Key Ecological Indicators and Green Performance Indicators. Process Discovery leverages existing BPM techniques and adds emission annotations to model the as-is process, taking into account both economic and environmental objectives. Issues of the as-is process and its environmental impacts are captured in Process Analysis using techniques such as Activity-Based Emission Analysis, Green Business Process Simulation, and so on. Besides the current methods and techniques employed, Process Redesign additionally uses Green Business Process Patterns and Energy-Aware Adaptation methods to address the ecological weaknesses recognized, resulting in the to-be (green) process model. In Process Implementation, Geographic Information Systems are utilized to realize the redesigned process. Finally, Process Monitoring & Controlling expands standard monitoring to incorporate Key Ecological Indicators and Green Performance Indicators, identified in the identification phase, along with Energy-Aware Adaptation to observe the performance of environment-oriented initiatives and determine new errors. Continuous improvements are also carried out in the Green BPM lifecycle. By incorporating environmentally specific components, the Green BPM lifecycle allows companies to manage business processes in an environmentally friendly manner to achieve SD.

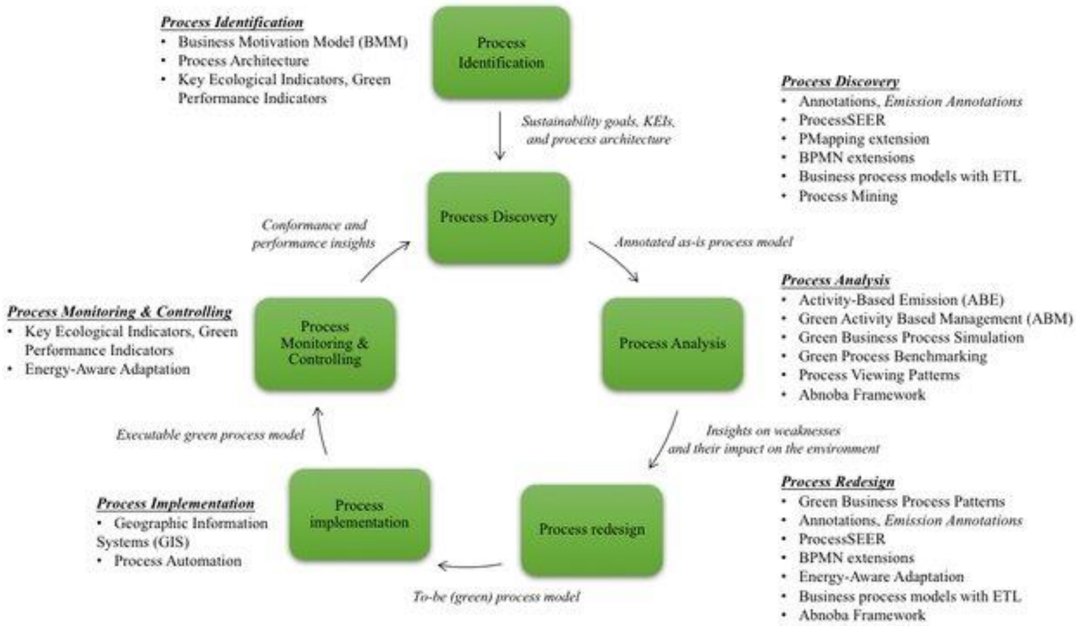

Fig. 2 The Green BPM Lifecycle (Maciel, 2017)

In academia, the relationship between BPM and SD has mostly focused on the environmental aspect. Green BPM has been defined in various ways (e.g., Ghose et al., 2010; Seidel et al., 2011; Houy et al., 2012; Opitz et al., 2014b) and has a dedicated lifecycle (Maciel, 2017), indicating that attention has been considerably drawn to ecological sustainability. However, social sustainability is often neglected (Carter & Rogers, 2008; Langella & Dao, 2011), failing to reach a complete and multidimensional view of SD through BPM (Schoormann et al., 2019).

2.4. RELATED WORKS

Relating to the topic of this study, nine review papers published from 2016 onwards, after the effective date of the 17 SDGs, have been identified. Some commonalities are found in these papers. First, all nine papers collectively recognized the role of BPM in achieving SD by exploring how different BPM aspects could be utilized to shift toward sustainability-oriented business processes. Second, the papers predominantly focused on the environmental pillar of sustainability. Several environmental impacts of business processes were taken into consideration, with most issues being carbon emissions and energy consumption (Couckuyt & Van Looy, 2019a; Couckuyt & Van Looy, 2019b; Hernández González et al., 2019; Gohar & Indulska, 2020; Graves et al., 2023; Maciel, 2017). Moreover, many studies highlighted the need for more empirical research and case studies to examine the effectiveness of BPM approaches investigated (Couckuyt & Van Looy, 2019a; Couckuyt & Van Looy, 2019b; Hernández González et al., 2019; Gohar & Indulska, 2020; Fritsch et al., 2022). The nine review papers can be organized into three categories based on their SD focus.

First, five papers focused solely on environmental sustainability. Maciel (2017) studied the six core elements of BPM created by Rosemann & vom Brocke (2015) to determine the key capabilities Green BPM required. Furthermore, the author presented a Green BPM lifecycle that incorporated environmental considerations into the traditional BPM lifecycle by Dumas et al. (2018). Couckuyt and Van Looy (2019a) assessed the scope, approaches, responsibility, researchers, and quality management of Green BPM, leading to a proposed research agenda and practical guidelines to enable progress in this field. In a separate study, Couckuyt and Van Looy (2019b) underscored the use of the BPM capability maturity model by Looy et al. (2014), including technical and managerial capabilities, in advancing Green BPM. Another paper by Hernández González et al. (2019) focused on adapting current BPM facets, such as lifecycle stages, management activities, and indicators, to include sustainability concerns. A new characteristic called "Process Greenability" to evaluate Green BPM was suggested in this study. Finally, Gohar and Indulska (2020) took a different approach, exploring how nine core BPM concepts (e.g., business process reengineering, process performance measurement, etc.) could support environmental sustainability in terms of environmental performance indicators and relevant organizational factors.

The second category, which considers the social aspect of sustainability besides the environmental dimension, has one paper. Schoormann et al. (2019) adopted a pattern-based approach to facilitate social sustainability in business processes and developed Socially Business Process Patterns (SBPPs) to handle social concerns specifically.

The last category considers all three pillars of sustainability: environmental, social, and economic. One paper by Schoormann et al. (2017) developed a taxonomy of approaches for designing sustainable business processes. Graves et al. (2023) focused on driving SD and the circular economy by applying process mining, the quantitative unit of BPM. The Process Mining for Sustainability (PM4S) framework was introduced in this study and served as a basis for additional process analysis to boost SD. Fritsch et al. (2022), on the other hand, conducted a tertiary review and proposed pathways combining BPM and Life Cycle Assessment (LCA) as a way to address existing limitations in Sustainable BPM research.

A recognized research gap in the existing reviews is that none of them have established the connection between BPM and the 17 SDGs, which means that BPM's capabilities in achieving the United Nations' 2030 Agenda and addressing 17 global sustainability challenges could have been underutilized. Furthermore, most studies focused solely on environmental sustainability, and only four out of nine covered multiple pillars beyond the environmental dimension (Schoormann et al., 2017; Schoormann et al., 2019; Graves et al., 2023; Fritsch et al., 2022). This current lack indicates there is a need for an overview of how BPM can contribute to SDGs with considerations paid to all three sustainability dimensions. Therefore, this study aims to give an overview of the latest BPM research efforts in fulfilling SDGs by adopting the systematic literature review (SLR) method. The study aims to identify which of the 17 SDGs are getting attention in BPM research and explore how sustainability is currently incorporated into the BPM lifecycle to enable the achievement of the SDGs. By revealing which SDGs are focused on, this study also covers all three SD pillars by employing the Wedding Cake model (Rockström & Sukhdev, 2016). Hernández González et al. (2019) and Maciel (2017) discussed the BPM lifecycle; however, their approaches are different from this study's approach. The former used the lifecycle approach proposed by Opitz et al. (2014b) (Design, Monitoring, Improvement, Implementation, and Operation stages), and the latter used the BPM capability model approach by Rosemann & vom Brocke (2015) (Strategic Alignment, Governance, Methods, Information Technology, People, and Culture), while this study uses the BPM lifecycle approach outlined by Dumas et al. (2018) (Identification, Discovery, Analysis, Redesign, Implementation, and Monitoring). The lifecycle model of Dumas et al. (2018) selected for this SLR provides a more detailed approach compared to that of Opitz et al. (2014b) because it includes Process Identification as a separate step and defines Process Discovery phase as a much broader activity than just process design, allowing for a thorough investigation of how sustainability is considered at each phase of the BPM lifecycle in the achievement of SDGs. Table 1 provides a comparison between this study and the related papers in terms of review dimensions.

Review Dimension	**(Maciel, 2017)**	**(Couckuyt & Van Looy, 2019a)**	**(Couckuyt & Van Looy, 2019b)**	**(Hernández González et al., 2019)**	**(Gohar & Indulska, 2020)**	**(Schoormann et al., 2019)**	**(Schoormann et al., 2017)**	**(Graves et al., 2023)**	**(Fritsch et al., 2022)**	**This Study**
Total number of papers reviewed	Primary papers (42)	Primary papers (60)	Primary papers (60)	Primary papers (56)	Primary papers (49)	Primary papers (12)	Primary papers (48)	Primary papers (14)	Seconda-ry papers (11)	Primary papers (43)
Reporting period	-	< 2019	< 2019	1990 - 2016	2005 - 2019	-	-	2010 - 2022	2012 - 2020	2016 - Now
Environmental Sustainability	x	x	x	x	x	x	x	x	x	x
Social Sustainability						x	x	x	x	x
Economic Sustainability							x	x	x	x
SDGs										x
BPM Lifecycle				x						x
BPM Methods	x			x		x	x	x	x	
BPM Capabilities	x	x	x	x	x				x	
BPM Definitions			x	x						
BPM Indicators				x	x					
BPM Traditions		x	x							
BPM General Concepts					x					
Dissemination Type		x	x	x	x				x	
Research Context		x						x	x	
Legend: x (included)										

Table 1. Comparison between earlier review papers and this paper

3. METHODOLOGY

This study aims to investigate the role of BPM in achieving SDGs by providing an overall view of current research attempts in the field. To achieve this research objective, the study adopted a systematic literature review (SLR) approach, following the method guided by Xiao and Watson (2019). SLR is a rigorous methodology to identify, evaluate, and translate relevant research works to a specific research question or topic of interest (Kitchenham, 2004). An SLR provides a structured overview of existing knowledge, facilitating the development of hypotheses and revealing gaps that further research can address (Webster & Watson, 2002). Due to the multidisciplinary nature of the topic, concerning both BPM and SD, a systematic review and analysis of relevant literature will help in understanding the current state of knowledge and contribute to the field of study. This section outlines the methodology applied to this study.

3.1. RESEARCH QUESTIONS

This study aims to investigate how BPM contributes to the achievement of SDGs. The research will first identify the specific SDGs that are the focus of BPM literature. Then, it will explore how sustainability is integrated into the BPM lifecycle to drive the accomplishment of the SDGs. The research questions were formulated as follows:

- RQ1: Which SDGs are focused on in BPM literature?
- RQ2: How is sustainability integrated into the BPM lifecycle?

By answering these two research questions, the study provides an overview of the current state of BPM research in advancing SDGs in particular and SD in general, as well as insights into sustainability-related methods, techniques, and tools that can be used during the BPM lifecycle. The study can be used by researchers and practitioners.

3.2. RESEARCH SCOPE

In order to search for available relevant literature, this study used three leading academic databases: Web of Science, Scopus, and IEEE Xplore. These databases were selected because they extensively covered scholarly publications across different disciplines. A wide range of studies on the intersection of BPM and SD can be obtained through these sources.

The literature search considered articles published from 2016 to the present. This time frame was purposefully chosen because it aligned with the effective date of the 17 SDGs by the United Nations (United Nations, 2015). Hence, this work can capture the most updated developments in the field of interest and evaluate how BPM has been leveraged to address these goals.

The search string was created through a preliminary literature review by the author. Keywords and variations used by the scholar community of the field were explored. To acquire papers regarding BPM, the term *"Business Process Management"* and its abbreviation *"BPM"* were included. Concerning literature on Sustainable Development and Sustainable Development Goals, the string contained the terms *"Sustainable Development"*, *"SD"*, *"SDG*"*, and variations of the term *"sustainability"* were presented using the wildcard *"Sustainab*"*. The term *"Green"* was included because it was commonly used to indicate environmental sustainability. While the environmental dimension has its dedicated term *"Green"*, the social and economic dimensions do not have specific terms to indicate sustainability. Hence, *"Triple Bottom Line"* along with its acronym *"TBL"* was included to capture the papers covering all three sustainability pillars, improving comprehensibility. Furthermore, *"GBPM"* and *"SBPM"* were included since they sometimes represented Green BPM and Sustainable BPM, respectively. To minimize the number of irrelevant records, the string excluded the terms "Bipolar Membrane", *"Beats Per Minute"*, *"Beam Position Monitor"*, and *"Blood Pressure Measurement"*, which were often abbreviated as BPM in academic research. The adopted query was as follows: *("Business Process Management" OR "BPM") AND ("Sustainable Development" OR "SD" OR "SDG*" OR "Sustainab*" OR "Triple Bottom Line" OR "TBL" OR "Green" OR "GBPM" OR "SBPM")*

NOT ("Bipolar Membrane" OR "Beats Per Minute" OR "Beam Position Monitor" OR "Blood Pressure Measurement"). This structure employed boolean operators *OR*, *AND*, *NOT* and wildcards (*) to secure all relevant articles comprising at least one term from each group while avoiding irrelevant terms, optimizing the relevance of the retrieved literature.

The author conducted the search in all possible fields of IEEE Xplore; within the *Article title, Abstract, Keywords* field of Scopus; and in *All fields* for Web of Science. The search in all three databases covered the period from 2016 to the present. In total, 1,444 records were generated from this initial search. Of these results, 101 papers were from IEEE Xplore, 561 were from Scopus, and 782 were from Web of Science.

3.3. SCREENING

After retrieving pieces of literature matching the search string, this study excluded the papers that met any of the following exclusion criteria:

- The paper is not relevant to BPM or SD or SDGs
- The paper is not focused on the role of BPM in achieving SD or SDGs
- The paper is not written in English
- The paper is not accessible on web browsers
- The paper is not peer-reviewed
- The paper is a literature review or a position paper

Figure 3 illustrates the paper selection process with the number of records selected and eliminated after each stage. After the duplicates were removed, 1,018 unique papers remained. Following the approach instructed by Xiao and Watson (2019), the screening process consisted of three phases: screening by title, by abstract, and finally by the full text of the paper. The screening was inclusive and iterative. If the information obtained was insufficient to decide whether a paper should be included, it was carried over to the following screening step. The list of excluded papers was kept for iteration purposes, avoiding any paper being overlooked. The first phase, title screening, involved excluding papers that clearly belonged to unrelated research areas such as Cardiovascular Systems, Sport Sciences, Physiology, Biology, Medicine, Chemistry, Energy, etc., or whose titles clearly demonstrated relationships among business management concepts outside the scope of this study. The screening of titles resulted in 253 for subsequent evaluation, with 765 articles removed. Screening the abstracts excluded 154 papers, leaving 99 papers for full-text screening. Out of these 99 papers, two non-English papers and 12 inaccessible papers were removed, and 85 papers available in full text remained. After the last full-text screening step, 42 papers were eliminated, resulting in a final set of 43 papers for the systematic literature review. The list of 43 papers analyzed in this SLR can be accessed from this link.

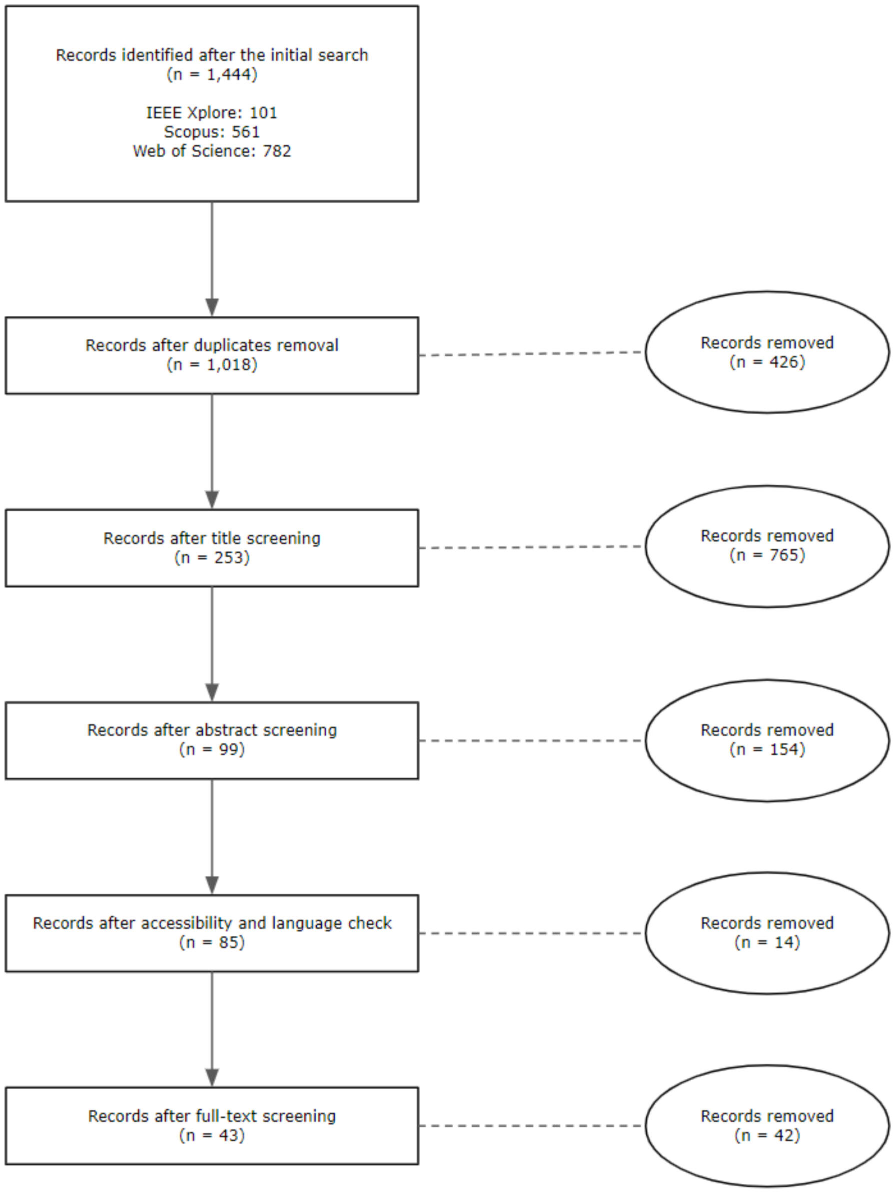

Fig. 3. Paper Selection Process

3.4. CODING SCHEME

This study used a coding scheme based on deductive coding techniques (Fereday & Muir-Cochrane, 2006) to extract information from the selected papers. This approach employed predefined codes mentioned in the study's background section to categorize information related to SDGs and BPM lifecycle stages.

For Research Question 1 (RQ1), the coding scheme included all 17 SDGs defined by the United Nations (United Nations, 2015). In cases where a paper did not specify its goal in SD, the value would be coded as *General Sustainable Development*. For Research Question 2 (RQ2), the scheme adopted six stages in the BPM lifecycle, as outlined by Dumas et al. (2018). If a paper did not discuss specific lifecycle phases involved, it would be classified as discussing *General BPM*. The codes and their descriptions are available in the Appendix.

4. RESULTS

This section presents the results of the SLR. It is essential to acknowledge that a single paper can cover more than one SDG and involve multiple phases of the BPM lifecycle. Thus, the total number of papers coded exceeds the 43 papers in the full-text review.

4.1. RESEARCH QUESTION 1

Figure 4 illustrates the number of papers across individual SDGs. *SDG 12 (Responsible Consumption and Production)* emerged as the most frequently focused goal, appearing in 27 papers (62.8%), followed closely by *SDG 11 (Sustainable Cities and Communities)* in 22 papers (51.2%). *SDG 7 (Affordable and Clean Energy)*, *SDG 14 (Life Below Water)*, and *SDG 15 (Life on Land)* were discussed in 18 papers each (41.9%), while *SDG 13 (Climate Action)* and *SDG 8 (Decent Work and Economic Growth)* were covered in 17 papers each (39.5%). *SDG 6 (Clean Water and Sanitation)* and *SDG 3 (Good Health and Well-being)* were addressed in 15 papers (34.9%) and 13 papers (30.2%), respectively. The remaining SDGs had less than ten papers each. Notably, *SDG 1 (No Poverty)*, *SDG 2 (Zero Hunger)*, *SDG 5 (Gender Equality)*, and *SDG 17 (Partnerships for the Goals*) each appeared in only one paper (2.3%). Finally, there were four papers (9.3%) that did not specify the goals they concentrated on, so they were classified as focusing on *General Sustainable Development*. The majority of the publications discussed the application of BPM as a holistic approach to improving business processes and mentioned that sustainability goals are a result of this approach. Only a few papers discussed the specific BPM techniques involved in specific processes.

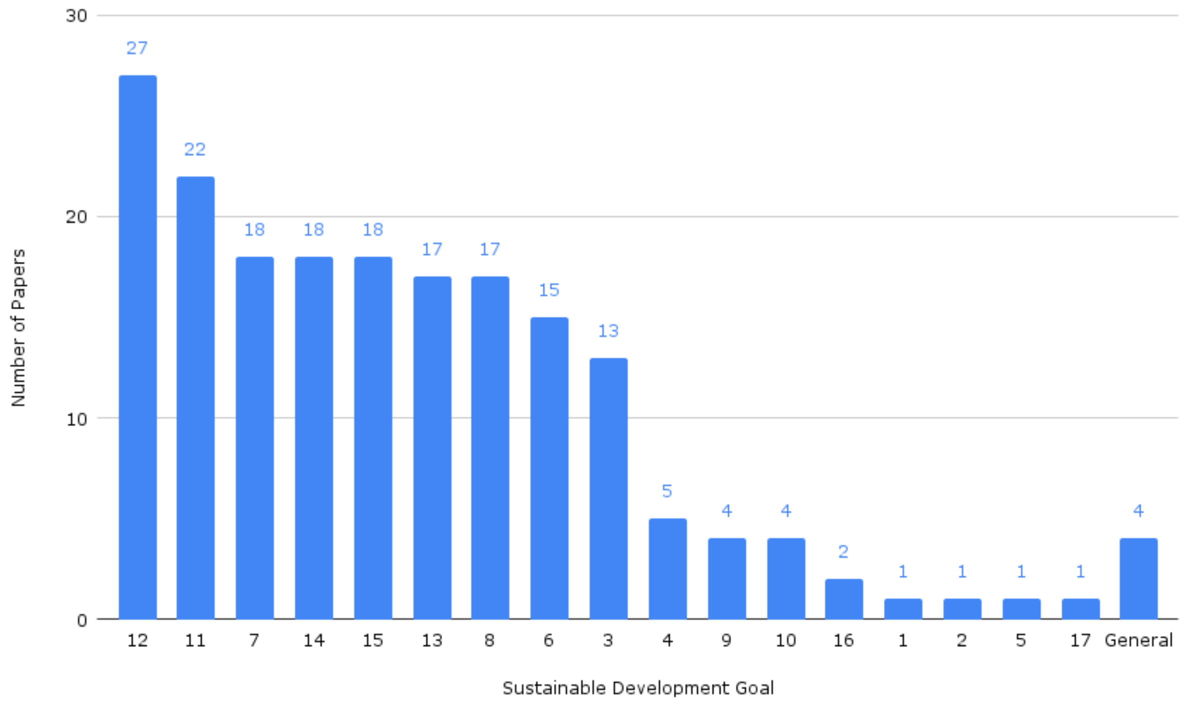

Fig. 4. SDGs focused on in BPM research

SDG 12 (Responsible Consumption and Production) (n = 27, 62.8%) has a dual focus: sustainable consumption and sustainable production. On the consumption side, the studies have focused on objectives such as saving energy by using automated process discovery method to monitor energy consumption of day-to-day processes (Delgado et al., 2023), reducing material consumption by employing a BPM system called Vienna Platform for Elastic Processes (ViePEP) to provision resources of the core processes in the cloud environment (Skarlat et al., 2016), or recycling the waste by employing Hybrid Service Simulator Model (HSSM) to visualize the impacts of circular economy strategies on the supply process (E. Guevara-Rivera et al., 2020). On the production side, the purposes were to minimize emissions by adopting the Business Processes Compliance Checking (BPCC) method in the process analysis phase to find ecological weaknesses of the processes (Lübbecke et al., 2018), and diminish releases of tar generated from the conversion process of biomass to energy by embracing the conventional process management activities: identifying, modeling, analyzing, executing, and monitoring (Gallotta et al., 2017).

SDG 11 (Sustainable Cities and Communities) (n = 22, 51.2%) aims at providing accessibility to safe and better living conditions for people. Several critical aspects of human settlements discussed were offering adequate housing for everyone by using BPMN to discover the as-is model and develop the to-be model of the Social Housing process (Mangialardi et al., 2022), improving air quality in urban areas by using agent-based modeling and process mining to simulate and compare ecological effects of healthcare processes (Sulis, 2023). In another study, air quality was enhanced by optimizing transportation processes using BPM techniques mediated by Quality 4.0, i.e., digital technologies like Artificial Intelligence, Machine Learning, and the Internet of Things to identify and track transportation patterns in the food manufacturing industry (Yanamandra et al., 2023). Disaster resilience enhancement to adapt to climate change was also emphasized using Predictive Process Monitoring, utilizing data from event logs to train models capable of predicting possibilities for digitized processes (Hehnle et al., 2024).

SDG 7 (Affordable and Clean Energy) (n = 18, 41.9%) is focused on energy efficiency by adjusting process execution order based on analysis of event logs using Predictive Process Monitoring (Hehnle et al., 2024), encouraging using renewable energy sources by modeling circular economy initiatives in the core processes using Hybrid Service Simulator Model (HSSM) (E. Guevara-Rivera et al., 2020), and enhancing access to energy in underserved areas by incorporating Environmental, Social, and Governance (ESG) principles into managing processes (Wu et al., 2024).

SDG 14 (Life Below Water) (n = 18, 41.9%) conserves marine biodiversity and oceans by mitigating aquatic pollution. For example, Gohar (2019) studied the development of EPI process notation to model the indicators tracking waste generation to water from core processes in the hospitality industry. Reducing effluents was enabled by the use of the Analytic Hierarchy Process (AHP) technique to perform a numerical evaluation of green practices over the entire chain of supply in the monitoring phase (Sellitto, 2018).

SDG 15 (Life on Land) (n = 18, 41.9%), on the other hand, aims to protect the ecosystems on land. Studies highlighted attempts to reduce soil degradation by identifying only processes critical to the green supply chain management for process improvement using the thematic analysis method via NVivo (Mc Loughlin et al., 2023). In another study, the Industrial Information Integration (III) approach was leveraged during the discovery phase to provide insights into the resource allocation and waste production problems of industrial business processes, with the aim of maintaining the lives of animals through reduction of pollutant waste (Strimovskaya & Barykin, 2023). However, sustainable forest and mountain management, an essential focus of this goal, was not found in any paper.

SDG 13 (Climate Action) (n = 17, 39.5%) emphasizes actions to deal with climate change. This goal is mainly reflected by research on reducing greenhouse gas emissions and carbon footprints using Green BPM practices combined with digital technologies (Yanamandra et al., 2023). Some other examples of this goal include calculating activity-based CO2 emissions in processes using the Process-Centric Energy Model (PCEM) in the analysis stage (Munsamy et al., 2019), modeling processes to build comprehensive emission inventories by swimlanes chart in the discovery step (Oncioiu et al., 2019), and planning climate adaptation strategies by tracking the amount of emissions reduced per kWh and analyzing event logs through Predictive Process Monitoring (Hehnle et al., 2024).

SDG 8 (Decent Work and Economic Growth) (n = 17, 39.5%) focuses on sustainable economic growth and decent work for everyone, primarily enabled through improving sustainable competitive advantage for organizations by applying process simulation and process benchmarking with the integration of Artificial Intelligence techniques to the main processes (Djordjevic et al., 2022) or by adopting continuous innovation discipline into operating processes (Madonsela et al., 2017). Additionally, Toymentseva et al. (2023) highlighted the importance of providing secure workplaces and career advancement opportunities by combining BPM methods with digital transformation to enhance the internal information exchange process. Cultural promotion is also an aspect of this goal and was facilitated through the model of processes and their sub-processes comprising cultural thematic routes using document analysis techniques combined with Product Lifecycle Management (PLM) (Palmi et al., 2021). In another study, Rodríguez et al. (2021) utilized traditional BPM techniques that were Value-added analysis, Root cause analysis, and Problem registration to address problems such as reprocesses, idle times, etc. in the post-harvest process to sustain the competitive advantage of a company in the floricultural industry.

SDG 6 (Clean Water and Sanitation) (n = 15, 34.9%) is about managing water and hygiene for people. Water conservation, accessibility, and safety are vital. These are achievable by reducing pollutants through the identification of ecological weaknesses in process models and the presentation of the process workflows with the ARIS tool, a mainstream BPM platform for process design, analysis, and implementation (e.g., Lübbecke et al., 2018) or by preventing water contamination using process simulation technique to compare the expected impact of different policies applied to the core processes in the healthcare industry (Sulis, 2023).

SDG 3 (Good Health and Well-being) (n = 13, 30.2%) ensures good health for everyone by preventing diseases caused by poisonous substance generation through the analysis of Ecological Workflow Patterns (EWPs), which were first identified by qualitative analysis techniques (interviews and catalog analysis) and then evaluated by modeling experts (Lübbecke et al., 2017). Not only was physical health discussed, but mental health and general well-being were also emphasized. BPM systems were used to ensure internal business processes ran smoothly, strengthening the company's economic security, reducing personnel risks, and fostering a safe working environment (Toymentseva et al., 2023). In the work of Ivana et al. (2022), process simulation was done using ADOSCORE and ADONIS tools to assess the impact of the knowledge management process, enabling personal and professional development.

The remaining goals received little attention, with less than ten papers for each goal. Education opportunities for everyone were emphasized by *SDG 4 (Quality Education)* (n = 5, 11.6%), which fosters lifelong learning, increases knowledge as well as skills for talent development, and empowers global citizens through the adoption of BPM systems, process simulation, and process modeling (e.g., Toymentseva et al., 2023; Ivana et al., 2022; Myszewski, 2016; Fleaca et al., 2018). *SDG 9 (Industry, Innovation and Infrastructure)* (n = 4, 9.3%) aims to build resilient infrastructure and facilities by modeling processes integrating circular economy principles with the use of Net-Logo software (E. Guevara-Rivera et al., 2020). *SDG 10 (Reduced Inequalities)* (n = 4, 9.3%) promotes social inclusion and reduces nation-level inequality by proposing an operational framework based on the Balanced Scorecard model (Yanine & Campos, 2023) and ensures fairness with ESG principles integrated into processes (Wu et al., 2024). Another aspect of this goal is to achieve equality among countries, but this has yet to appear in the papers investigated. *SDG 16 (Peace, Justice and Strong Institutions)* (n = 2, 4.7%), which secures social justice and peace for inclusive communities, was enhanced with the development of a conceptual framework incorporating ethical and compliance management with BPM to identify variables affecting the sustainability of the processes before discovery phase (Soler et al., 2024). Remarkably, *SDG 1 (No Poverty)*, *SDG 2 (Zero Hunger)*, *SDG 5 (Gender Equality)*, and *SDG 17 (Partnerships for the Goals*) appeared in only one paper (Chechenova, 2023). *SDG 1 (No Poverty)* (n = 1, 2.3%) was about maintaining a competitive wage level, *SDG 2 (Zero Hunger)* (n = 1, 2.3%) focused on delivering food to remote areas of the country, *SDG 5 (Gender Equality)* (n = 1, 2.3%) was piloted with a project of increasing the birth rate and supporting pregnant women and motherhood, and *SDG 17 (Partnerships for the Goals*) (n = 1, 2.3%) outlined the joining national alliances to participate in international cooperations actively. In this paper, the author discussed how a transport company worked towards these SDGs by modifying the existing ESG-indicators System to monitor process performance in each ESG aspect, such as the number of human accidents, human rights violations, spending on social programs, percentage of women leaders on the management board, etc. (Chechenova, 2023). Finally, *General Sustainable Development* has four papers (n = 4, 9.3%) investigating the role of BPM in general SD without specifying objectives that could be classified into the SDGs (Couckuyt & Van Looy, 2021a; Larsch et al., 2017; Büdel et al., 2020; Plattfaut, 2022). Büdel et al. (2020) used dashboards to track the sustainability performance of processes, while Plattfaut (2022) emphasized the significance of project management capabilities in sustainable BPM.

4.2. RESEARCH QUESTION 2

It was discussed in the background section that to leverage the power of BPM in achieving SD and SDGs, sustainability must be integrated into the BPM lifecycle. RQ2 aims to reveal how the integration is carried out by exploring what BPM methods, tools, and techniques are adopted and at which stage they are used. Figure 5 depicts the number of papers across the six stages of the BPM lifecycle. The *Process Redesign* phase holds the highest representation (n = 14, 32.6%), followed closely by *Process Analysis* and *Process Discovery* (n = 11, 25.6%). The other stages are discussed in less than 20% of the papers examined, including *Process Monitoring* (n = 8, 18.6%), *Process Identification* (n = 7, 16.3%), and *Process Implementation* (n = 2, 4.7%). With the papers not discussing a specific lifecycle phase, the study categorizes them as *General BPM* (n = 14, 32.6%).

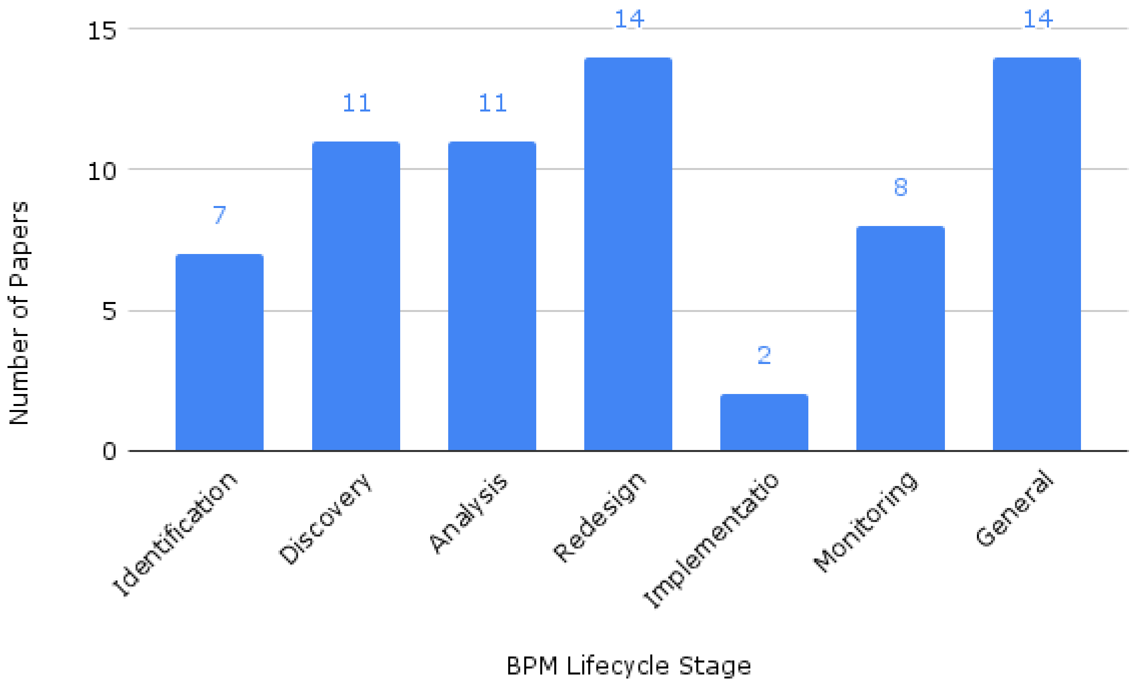

Fig. 5. BPM Lifecycle Stages

In the *Process Identification* stage, the literature highlighted the importance of defining the process architecture and conducting process selection to steer the integration of sustainability. To conceptualize the process architecture of an educational model, Fleaca et al. (2018) employed the SIPOC method (Supplier, Input, Process, Output, Customer), accompanied by a scoping diagram tool and Visio software to drive *SDG 4*. Process selection is also necessary during this stage. For example, Mc Loughlin et al. (2023) identified eight processes, which were critical to sustainable supply chain management, for improvement to reduce carbon emissions and enhance energy efficiency (*SDG 7, SDG 11, SDG 12, SDG 13*) through thematic analysis via NVivo and processes' explanatory power assessment, while Stojanovic et al. (2020) formalized the procedure for Business Process Prioritization (BPP) approach with clear predefined criteria to select processes for improvement, creating sustainable competitive advantage (*SDG 8*). Moreover, the identification step is concerned with determining the required sustainability indicators, which can be variables or aspects impacting SD performance, leading to the design, activities, and objects forming in the following process discovery stage (Soler et al., 2024). Ivana et al. (2022), in the education environment, used graduates' satisfaction level towards the transferred competencies as a sustainability indicator to enable SD of academic curriculum and education opportunities (*SDG 3, SDG 4, SDG 8*), while Oncioiu et al. (2019) considered environmental indicators based on air concentrations of sedimental and suspended powders for the mining industry to track and minimize air emissions, dust emissions, and pollutants (*SDG 11, SDG 12, SDG 13, SDG 15*). However, the BPM methods used to identify the sustainability indicators were not explained in detail.

The *Process Discovery* stage involves gathering information to understand the existing process (as-is process) before sustainability improvements are proposed. Palmi et al. (2021) adopted the traditional document analysis with the aid of technologies to collect information regarding the current core process. In the work of Strimovskaya and Barykin (2023), information was obtained by applying an approach called Industrial Information Integration (III), building insights into resource allocation challenges associated with zero-level emission objectives within complicated industrial system architectures (*SDG 11, SDG 12, SDG 13, SDG 14, SDG 15*). Discussion panels with the participation of process actors were also conducted to gain information to innovate the Social Housing System (*SDG 11*), helping with generalization, standardization, and shared terminology creation and resulting in a high-level Social Housing Process Reference Model in the study of Mangialardi et al. (2022). Following the collection of information, process modeling techniques were frequently adopted to create specific models presenting how the processes within an architecture were managed and to drive the integration of sustainability from ideation to model creation (e.g. Mc Loughlin et al., 2023; E. Guevara-Rivera et al., 2020; Larsch et al., 2017; Oncioiu et al., 2019). A specific example is described in the study of E. Guevara-Rivera et al. (2020), where Net-Logo software was used to build a Hybrid Service Simulators Model (HSSM) to facilitate the understanding of system behavior and visualize circular economy strategies, aiming to reduce waste, encouraging using renewable energy sources and recycling (*SDG 6, SDG 7, SDG 9, SDG 11, SDG 12*). In another paper, modeling was done with tools ADONIS and ADOSCORE to build a spiral model, demonstrating how culture and knowledge transfer interacted within an institution (Ivana et al., 2022). Many works employed the traditional business process modeling notation (BPMN) (e.g., Mangialardi et al., 2022; Gayialis et al., 2022; Gohar, 2019). Gayialis et al. (2022) used BPMN to present the processes of a blockchain-enabled traceability system to enhance transparency and accountability in the supply chain (*SDG 12*), while Gohar (2019) extended the use of BPMN to develop the specialized notation for EPI, used to measure consumption of energy, water, and generation of greenhouse gas (GHG) (*SDG 3, SDG 6, SDG 11, SDG 12, SDG 13, SDG 14, SDG 15*).

In the *Process Analysis* stage, process modeling, process simulation, and process benchmarking are major approaches. For instance, agent-based modeling was used to generate event logs for process mining to compare the environmental effects of different scenarios in an effort to reduce emissions (Sulis, 2023). Artificial intelligence techniques were adopted to further enhance not only simulation but also benchmarking and verifying outcomes of multiple strategies to create sustainable competitive advantage (*SDG 8*) (Djordjevic et al., 2022). Munsamy et al. (2019) utilized the Business Process-Centric Energy Model (PCEM) to quantify the expected energy consumption of the process and identify the most energy-consumed activities, preparing for process reengineering to reduce energy, waste, and GHG emissions (*SDG 6, SDG 11, SDG 12, SDG 13, SDG 14, SDG 15*). Following analysis, the identified bottlenecks can be organized and classified. Mangialardi et al. (2022) categorized the primary issues into areas associated with standardization, lifecycle, coordination, technologies, and procedures. Alternatively, Lübbecke et al. (2016) introduced Ecological Workflow Patterns (EWPs) after formalizing the identified weaknesses. After this pattern proposal, in a later work, Lübbecke et al. (2017) developed a catalog of Ecological Process Patterns (EPP) by combining the identified patterns and carrying out new pattern investigations. Employing these patterns, Lübbecke et al. (2018) clustered them and applied Compliance Checking methods to create a Compliance Checking Method Library for further issue identification and analysis in process models.

The *Process Redesign* develops solutions to improve existing processes (as-is processes) more sustainably, creating to-be processes. Lübbecke et al. (2018) suggested using the identified weakness patterns as a guide to generate optimization options for the reduction of resource consumption, pollutants, and emissions (*SDG 3, SDG 6, SDG 11, SDG 12, SDG 13, SDG 14, SDG 15*). These patterns can be used to build an extension for the existing BPM platform ARIS, aiding in finding new issues and modeling process flows using the same software (Lübbecke et al., 2018). Zhao et al. (2018) discussed another approach, which was to consider the context in which processes operate. Event streams were received for context modeling tasks, providing real-time contextual dynamics and allowing process adaptation (Zhao et al., 2018). Maturity models like the Cultural and Creative Industries Process and Enterprise Maturity Model (CCIs PEMM) helped assess how well organizations could manage processes and recommend improvements to reduce cost, reduce time, and promote circular economy strategies when competing in the European market (*SDG 8, SDG 12*) (S. Signore et al., 2021). An energy model can also be employed, and this Process Centric Energy Model (PCEM) was developed with the assistance of Microsoft Excel VBA in the work of Munsamy et al. (2019) to offer an optimization database that allowed process actors to choose more energy-saving alternatives. Several alternative technologies were variable speed motors for compressors, supercritical boilers, and new energy-efficient servers (Munsamy et al., 2019). Additionally, a redesign solution could be scheduling highly energy-consumed activities when more sustainable energy, such as solar power, was available to reduce CO2 emissions and energy used (*SDG 6, SDG 7, SDG 11, SDG 12, SDG 13, SDG 14, SDG 15*) (Hehnle et al., 2024). The BPMN was often used in this phase to model the to-be processes (e.g., Mangialardi et al., 2022; Ahlers et al., 2017; Gohar, 2019), but other tools like swim-lane charts can also be helpful (Oncioiu et al., 2019).

The *Process Implementation* is the least explored stage in the papers examined. Skarlat et al. (2016) discussed the execution of elastic processes in cloud environments and the adoption of the Vienna Platform for Elastic Processes (ViePEP) to select services for business processes, also called service orchestration. To be more specific, the matter of energy restriction was taken into consideration about timing and resource allocation. An extension to monitor energy indicators during runtime was developed on ViePEP, leading to a near-optimal plan with partial re-implementation at runtime aiming to reduce the use of materials and energy (*SDG 7, SDG 12*) (Skarlat et al., 2016). In another study, partial implementation of to-be models was enabled by the incorporation of Building Information Modelling (BIM), Case-Based-Reasoning (CBR) approach, and predictive maintenance policies in managing Social Housing System (*SDG 11*) (Mangialardi et al., 2022).

The *Process Monitoring* step focuses on tracking and assessing executed process performance to ensure sustainability. Chechenova (2023) modified the existing ESG-indicators System to track sustainability performance across multiple processes. Delgado et al. (2023) combined the framework FEETINGS (Framework for Energy Efficiency Testing to Improve Environmental Goals of the Software), the hardware EET (Energy Efficiency Tester), and the automated process discovery method to monitor energy usage (*SDG 12*). The authors also introduced an extending component of the automated process discovery benchmark to include energy sustainability considerations (Delgado et al., 2023). Quality 4.0 and the growth of Machine Learning and Artificial Intelligence were developed to observe ecological performance in terms of carbon emissions and energy consumption and suggest necessary changes to create a sustainable competitive advantage (*SDG 7, SDG 8, SDG 12, SDG 13*) (Yanamandra et al., 2023). Another study by Hehnle et al. (2024) discussed the adoption of Predictive Process Monitoring, empowered by machine learning models trained on historical event logs, predicting the time left or upcoming activities. The gained insights were utilized to estimate the flexibility for delaying activities until lower carbon-intensive energy was usable, facilitated by the Workflow Management System and Camunda (Hehnle et al., 2024). Dashboards also played a vital role in monitoring an organization's sustainability performance, offering a holistic view of goal values and corresponding indicators (Büdel et al., 2020).

The remaining papers, which did not specify a particular stage, discussed different approaches that can be applied to the entire lifecycle to incorporate sustainability. For instance, a study emphasized the necessity of integrating ESG principles into processes to enhance all three sustainability pillars and achieve multiple SDGs (*SDG 7, SDG 8, SDG 9, SDG 10, SDG 11, SDG 12*) (Wu et al., 2024). Other studies highlighted continuous innovation discipline as a critical factor in enhancing sustainable competitive advantage (*SDG 8*) (Madonsela et al., 2017; Myszewski, 2016). Similarly, organizations should conduct frequent accountability revisions to ensure strategic alignment with sustainability objectives such as minimizing impact on wildlife habitats, preventing water contamination, and improving human lives (*SDG 6, SDG 11, SDG 12, SDG 13, SDG 14, SDG 15*) (AlNuaimi et al., 2020). Such alignment can be enabled by effective communication across different levels within a company, from the managerial level to the operational level (Yanine & Campos, 2023). Toymentseva et al. (2023) further highlighted the importance of communication by discussing the need to create information exchange systems, such as automatic reporting systems and planning systems, to improve workplace quality and subsequently improve employees' life quality (*SDG 3, SDG 4, SDG 8*).

5. DISCUSSION

This section discusses the results of the study and its implications for both research and practice.

5.1. RESEARCH QUESTION 1

BPM has demonstrated its ability to address all 17 SDGs to some extent. However, the level of focus across these goals is uneven. The most substantial emphasis has been on *SDG 12 (Responsible Consumption and Production)*, which is not surprising. This is likely due to BPM's inherent strength in optimizing resource use and managing waste using well-established methods, techniques, and tools. Many traditional techniques were utilized to achieve SD, such as automated process discovery (Delgado et al., 2023), process mining (Sulis, 2023), BPM systems (Skarlat et al., 2016), process simulation (E. Guevara-Rivera et al., 2020), value-added analysis (Rodríguez et al., 2021), etc. to identify and eliminate inefficiencies that consume resources without contributing to the desired outcomes or that generate waste causing many post-process problems. Enhancing resource consumption efficiency and waste management not only contributes to SD but also aligns with financial goals by reducing costs incurred from resource allocation and waste disposal activities.

BPM has also shown its promising role in achieving *SDG 7 (Affordable and Clean Energy)*, *SDG 11 (Sustainable Cities and Communities)*, *SDG 13 (Climate Action)*, *SDG 14 (Life Below Water)*, and *SDG 15 (Life on Land)*, primarily through its ability to improve processes that reduce waste aligning *SDG 12 (Responsible Consumption and Production)*. Studies aimed to reduce emissions, pollutants, and poisonous substances, thereby enhancing the quality of life for both humans and ecosystems while mitigating climate change. The methods and techniques adopted for achieving these goals were a mixture of traditional ones used in accomplishing *SDG 12 (Responsible Consumption and Production)* and sustainability-focused techniques such as the Process-Centric Energy Model (PCEM) (Munsamy et al., 2019), Ecological Workflow Patterns (EWPs) (Lübbecke et al., 2017), or extended EPI process notation (Gohar, 2019) and so on. However, BPM's role in achieving certain SDGs that are *SDG 1 (No Poverty)*, *SDG 2 (Zero Hunger)*, *SDG 4 (Quality Education), SDG 5 (Gender Equality)*, *SDG 9 (Industry, Innovation and Infrastructure), SDG 10 (Reduced Inequalities), SDG 16 (Peace, Justice and Strong Institutions),* and *SDG 17 (Partnerships for the Goals*) remains less evident. This could be attributed to the nature of these goals, which often encompass broader issues that may not be directly addressed through BPM alone.

Applying The Wedding Cake model (Rockström & Sukhdev, 2016), the study revealed that the economic pillar (n = 40, 93%) received the most attention, driven primarily by the focus of BPM research on *SDG 12 (Responsible Consumption and Production)* and *SDG 8 (Decent Work and Economic Growth)*. The social pillar (n = 33, 76.7%) followed, and the environmental pillar (n = 24, 55.8%) received the least focus, with a difference of approximately 20%, suggesting a potential prioritization of human well-being over ecological matters when BPM is applied. This result is contrary to a finding in the background section, which stated that social sustainability was often neglected in BPM research (Carter & Rogers, 2008; Langella & Dao, 2011). The appearance of three SD pillars in BPM research is shown in Figure 6.

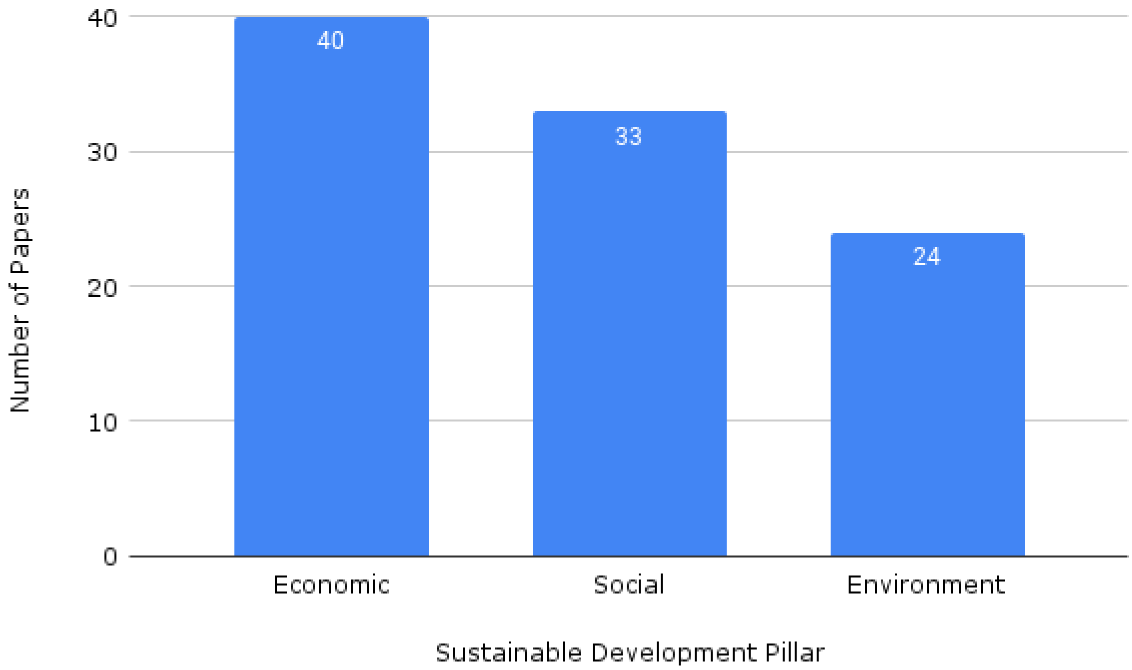

Fig. 6. Sustainable Development Pillars in BPM Research

Overall, the awareness of the 17 SDGs seems to be not well-established yet in BPM research since the sustainability goals discussed were still high-level (e.g., reducing emissions, reducing carbon footprint, saving energy, improving livelihoods, etc.). Moreover, most papers discussed how BPM can improve business processes holistically without delving into particular BPM methods, techniques, and tools. The SLR also revealed that current BPM research primarily focuses on economic sustainability due to its strength in improving resource utilization and minimizing waste to reduce business costs. Furthermore, BPM has shown its evolving application in addressing many social sustainability issues and has proven that the social dimension is not ignored in the field, contrary to the findings of Carter & Rogers (2008) and Langella & Dao (2011). This contradiction could be attributed to earlier studies not fully considering the interconnected nature of the three sustainability pillars and the broader implications of environmental goals on social and economic dimensions. For example, reducing carbon footprint and greenhouse gas emissions not only addresses climate change (environmental sustainability) but also improves human health and quality of life (social sustainability). This indicated a growing recognition of the interconnectedness of sustainability pillars within BPM research and practice. To fully leverage the potential of BPM for SD, future research should prioritize exploring the role of BPM in achieving 17 SDGs following the exact definitions and descriptions established by the United Nations in the 2030 Agenda, especially the underrepresented SDGs. In addition, studies of the specific BPM methods, techniques, and tools adopted in each SDG are encouraged.

5.1. RESEARCH QUESTION 2

The result of RQ2 revealed that all stages of the BPM lifecycle have been involved in driving SDGs, and the emphasis was on *the Process Redesign, Process Discovery*, and *Process Analysis* stages.

This highlights a practical approach within organizations to improve their current operations for sustainability. A variety of methods, techniques, and tools were discussed in these stages. Throughout the BPM lifecycle, several recurring themes were identified.

Firstly, existing BPM methods, techniques, and tools were still used to drive SDGs. Process modeling, process simulation, process benchmarking, and process mining were adopted across multiple stages. The use of BPMN, BPM Systems, Workflow Management Systems, and other tools indicated that traditional BPM remained effective when organizations considered sustainability. Additionally, the influence of information technology was emphasized, with the application of software like Visio, NVivo, Net-Logo, ADONIS, ADOSCORE, and ViePEP being utilized at different stages to achieve various sustainability purposes such as saving energy, reducing waste, and recycling materials. The employment of Artificial Intelligence and Machine Learning in the studies further demonstrated the BPM research community's awareness of the rise of cutting-edge technologies and their application to address sustainability issues.

Secondly, the extension or modification of existing BPM methods was another prevalent trend. The (EPI) notation was extended on traditional BPMN to visualize SD initiatives on process models and indicators of natural resource consumption and waste production. Sust inability-oriented features were developed on existing BPM platforms, such as adding a traceability feature to the ARIS platform or developing an energy monitor on ViePEP. Modifications were also made to the existing ESG-indicators System to monitor various aspects of sustainability. The extension and modification trend indicated that existing features or elements of BPM were still relevant in achieving SDGs, and they were flexible and adaptable to integrate sustainability considerations.

Thirdly, the SLR highlighted efforts to apply and develop sustainability-specific methods. On the one hand, Energy-related frameworks and models adopted were the Framework for Energy Efficiency Testing to Improve Environmental Goals of the Software (FEETINGS), Energy Efficiency Tester (EET), and Process-Centric Energy Model (PCEM). On the other hand, environmental-oriented patterns and methods developed were Ecological Workflow Patterns (EWPs), Ecological Process Patterns (EPPs), Compliance Checking Method Libraries, and Hybrid Service Simulation Model (HSSM). The results indicated a growing interest in standardizing sustainable BPM practices, which allow organizations to systematically identify and address sustainability-related issues in their processes.

Although most publications did not provide detailed approaches to achieve SDGs through BPM, the overall consensus was that BPM could support SD initiatives by utilizing traditional BPM, extending traditional BPM, and developing sustainability-specific BPM. This study expanded the Green BPM lifecycle of Maciel (2017) by adding notable approaches and methods investigated throughout the SLR to derive a catalog of state-of-the-art BPM to achieve SDGs. The expansion was based on the research condition of the methods, selecting only the methods that were discussed thoroughly, backed up by extensive research evidences, and not high-level. The catalog consolidating state-of-the-art BPM in driving SDGs can be referenced for future works in research and practice. Table 2 illustrates the proposed catalog.

BPM Lifecycle Stage	(Maciel, 2017)	This study
Process Identification	• Business Motivation Model (BMM) • Process Architecture • Key Ecological Indicators (KEI) • Green Performance Indicators	
Process Discovery	• Annotations, Emission Annotations • ProcessSEER • PMapping extension • BPMN extensions • Business process models with ETL • Process Mining	• Hybrid Service Simulator Model (HSSM) (E. Guevara-Rivera et al., 2020) • EPI process notation (Gohar, 2019)
Process Analysis	• Activity-Based Emission (ABE) • Green Activity Based Management (ABM) • Green Business Process Simulation • Green Process Benchmarking • Process Viewing Patterns • Abnoba Framework	• Process-Centric Energy Model (PCEM) (Munsamy et al., 2019) • Ecological Workflow Patterns (EWPs) (Lübbecke et al., 2016) • Ecological Process Patterns (EPP) (Lübbecke et al., 2017) • Compliance Checking Methods & Compliance Checking Method Library (Lübbecke et al., 2018)
Process Redesign	• Green Business Process Patterns • Annotations, Emission Annotations • ProcessSEER • BPMN extensions • Energy-Aware Adaptation • Business process models with ETL • Abnoba Framework	• EPI process notation (Gohar, 2019) • Process-Centric Energy Model (PCEM) (Munsamy et al., 2019) • Ecological Workflow Patterns (EWPs) (Lübbecke et al., 2016) • Ecological Process Patterns (EPP) (Lübbecke et al., 2017) • Compliance Checking Methods & Compliance Checking Method Library (Lübbecke et al., 2018)
Process Implementation	• Geographic Information Systems (GIS) • Process Automation	
Process Monitoring	• Key Ecological Indicators, Green Performance Indicators • Energy-Aware Adaptation	• Framework for Energy Efficiency Testing to Improve Environmental Goals of the Software (FEETINGS) (Delgado et al., 2023) • Energy Efficiency Tester (EET) (Delgado et al., 2023)

Table 2. The Proposed Catalog of state-of-the-art BPM to achieve SDGs

Overall, these findings offer valuable insights into the diverse approaches employed in BPM, particularly through the BPM lifecycle, to achieve SDGs. The most widespread tendency revealed was adapting or extending already existing methods, techniques, and tools in BPM, especially in the stages of *Discovery*, *Analysis*, and *Redesign*, leaving the other stages in the BPM lifecycle as future works.

6. CONCLUSION

The study has successfully addressed the research questions by identifying the SDGs that have received attention in BPM research and exploring how sustainability considerations are integrated into the BPM lifecycle. The findings revealed that while BPM has the potential to contribute to all 17 SDGs, the focus is primarily on economic sustainability, followed by social and then environmental sustainability. The study also highlighted various methods and techniques employed across different BPM lifecycle stages, contributing to the development of a catalog consolidating state-of-the-art BPM approaches for achieving SDGs. This catalog can serve as a valuable reference for both research and practice, guiding future endeavors in leveraging BPM for SDGs. However, it is important to acknowledge the limitations of this study. Firstly, the investigation might carry embedded bias due to certain assumptions, while the intricate interconnections among the SDGs might not be entirely illuminated. Secondly, the coding of the paper was carried out by a single individual, potentially introducing bias. Lastly, the limited knowledge and exposure of the author in the field could affect the interpretation of the findings. To unlock the full potential of BPM for SDGs, future research needs to prioritize exploring the specific role of BPM in achieving each of the 17 SDGs, employing the precise definitions established by the United Nations. Additionally, detailed studies of sustainability-specific BPM methods, techniques, and tools are encouraged, which can be used to further expand the catalog offered in this SLR. Future empirical research is also necessary to validate the proposed catalog.

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APPENDIX

Category	Description
SDG 1	End poverty in all its forms everywhere (United Nations, 2015)
SDG 2	End hunger, achieve food security and improved nutrition and promote sustainable agriculture (United Nations, 2015)
SDG 3	Ensure healthy lives and promote well-being for all at all ages (United Nations, 2015)
SDG 4	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all (United Nations, 2015)
SDG 5	Achieve gender equality and empower all women and girls (United Nations, 2015)
SDG 6	Ensure availability and sustainable management of water and sanitation for all (United Nations, 2015)
SDG 7	Ensure access to affordable, reliable, sustainable and modern energy for all (United Nations, 2015)
SDG 8	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all (United Nations, 2015)
SDG 9	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation (United Nations, 2015)
SDG 10	Reduce inequality within and among countries (United Nations, 2015)
SDG 11	Make cities and human settlements inclusive, safe, resilient and sustainable (United Nations, 2015)
SDG 12	Ensure sustainable consumption and production patterns (United Nations, 2015)
SDG 13	Take urgent action to combat climate change and its impacts (United Nations, 2015)
SDG 14	Conserve and sustainably use the oceans, seas and marine resources for sustainable development (United Nations, 2015)
SDG 15	Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss (United Nations, 2015)
SDG 16	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels (United Nations, 2015)
SDG 17	Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development (United Nations, 2015)

Table 3. 17 SDGs (United Nations, 2015)

Category	Description
SDG 1	End poverty in all its forms everywhere (United Nations, 2015)
SDG 2	End hunger, achieve food security and improved nutrition and promote sustainable agriculture (United Nations, 2015)
SDG 3	Ensure healthy lives and promote well-being for all at all ages (United Nations, 2015)
SDG 4	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all (United Nations, 2015)
SDG 5	Achieve gender equality and empower all women and girls (United Nations, 2015)
SDG 6	Ensure availability and sustainable management of water and sanitation for all (United Nations, 2015)
SDG 7	Ensure access to affordable, reliable, sustainable and modern energy for all (United Nations, 2015)
SDG 8	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all (United Nations, 2015)
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SDG 16	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels (United Nations, 2015)
SDG 17	Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development (United Nations, 2015)
General SD	A paper focusing on sustainable development but not specifying the goals focused

Table 4. Set of codes for Sustainable Development Goals (SDGs)

Category	Description
Process Identification	Identifying and defining the scope of business processes, resulting in a process architecture (Dumas et al., 2018)
Process Discovery	Documenting the current state of the as-is process models (Dumas et al., 2018)
Process Analysis	Identifying and analyzing issues and bottlenecks in the as-is processes (Dumas et al., 2018)
Process Redesign	Developing solutions to address the identified issues, resulting in redesigned to-be process models (Dumas et al., 2018)
Process Implementation	Implementing the changes required to move from the as-is process to the to-be process (Dumas et al., 2018)
Process Monitoring	Continuously monitoring the redesigned process to ensure it performs as expected and identify further improvement opportunities (Dumas et al., 2018)
General BPM	A paper focusing on sustainable development but not specifying BPM lifecycle stages focused

Table 5. Set of codes for BPM Lifecycle Stages

REFERENCES

Aalst, W. (2003). Business Process Management Demystified: A Tutorial on Models, Systems and Standards for Workflow Management (Vol. 3098, p. 65). https://doi.org/10.1007/978-3-540-27755-2_1

Ahlers, D., Krogstie, J., Driscoll, P., Lundli, H., Loveland, S., Rothballer, C., & Wyckmans, A. (2017). Supporting Municipal Greenhouse Gas (GHG) Emission Inventories Using Business Process Modeling: A Case Study of Trondheim Municipality (M. Dumas & M. Fantinato, Eds.; WOS:000724486700033; Vol. 281, pp. 416–427). https://doi.org/10.1007/978-3-319-58457-7_30

AlNuaimi, B., Al Mazrouei, M., & Jabeen, F. (2020). Enablers of green business process management in the oil and gas sector. INTERNATIONAL JOURNAL OF PRODUCTIVITY AND PERFORMANCE MANAGEMENT, 69(8), 1671–1694. https://doi.org/10.1108/IJPPM-11-2019-0524

Barbier, E. B., & Burgess, J. C. (2017). The Sustainable Development Goals and the systems approach to sustainability. Economics, 11(1). https://doi.org/10.5018/economics-ejournal.ja.2017-28

Barta, S., Belanche, D., Flavián, M., & Terré, M. C. (2023). How implementing the UN sustainable development goals affects customers' perceptions and loyalty. Journal of Environmental Management, 331, 117325. https://doi.org/10.1016/j.jenvman.2023.117325

Bergman, Z., Bergman, M. M., Fernandes, K., Grossrieder, D., & Schneider, L. (2018). The Contribution of UNESCO Chairs toward Achieving the UN Sustainable Development Goals. Sustainability, 10(12), Article 12. https://doi.org/10.3390/su10124471

Blix, T., & Myhr, A. (2022). A sustainability assessment framework for genome-edited salmon. Aquaculture, 562, 738803. https://doi.org/10.1016/j.aquaculture.2022.738803

Block, T. (2020). An indivisible set of sustainability goals: SDGs in research and education at UGent. http://hdl.handle.net/1854/LU-8764355

Bubenik, P., Capek, J., Rakyta, M., Binasova, V., & Staffenova, K. (2022). Impact of Strategy Change on Business Process Management. SUSTAINABILITY, 14(17). https://doi.org/10.3390/su141711112

Büdel, V., Fritsch, A., & Oberweis, A. (2020). Integrating sustainability into day-to-day business: A tactical management dashboard for O-LCA. 56–65. https://doi.org/10.1145/3401335.3401665

Butler, T. (2011). Compliance with institutional imperatives on environmental sustainability: Building theory on the role of Green IS. The Journal of Strategic Information Systems, 20(1), 6–26. https://doi.org/10.1016/j.jsis.2010.09.006

Carter, C., & Rogers, D. (2008). A Framework of Sustainable Supply Chain Management: Moving Toward New Theory. International Journal of Physical Distribution & Logistics Management, 38, 360–387. https://doi.org/10.1108/09600030810882816

Chechenova, L. (2023). Ensuring the environmental safety of a transport company in the direction of achieving sustainable development goals. E3S Web of Conferences, 460, 06028. https://doi.org/10.1051/e3sconf/202346006028

Couckuyt, D., & Van Looy, A. (2019a). Green BPM as a Business-Oriented Discipline: A Systematic Mapping Study and Research Agenda. Sustainability, 11(15), Article 15. https://doi.org/10.3390/su11154200

Couckuyt, D., & Van Looy, A. (2021a). An empirical study on Green BPM adoption: Contextual factors and performance. JOURNAL OF SOFTWARE-EVOLUTION AND PROCESS, 33(3). https://doi.org/10.1002/smr.2299

Couckuyt, D., & Van Looy, A. (2021b). An exploration of green business process maturity based on ecolabels. BUSINESS PROCESS MANAGEMENT JOURNAL, 27(7), 1999–2020. https://doi.org/10.1108/BPMJ-05-2021-0293

Couckuyt, D., & Van Looy, L. A. (2019b). A systematic review of Green Business Process Management. Business Process Management Journal, 26(2), 421–446. https://doi.org/10.1108/BPMJ-03-2019-0106

Delgado, A., García, F., Moraga, M. Á., Calegari, D., Gordillo, A., & Peña, L. (2023). Adding the Sustainability Dimension in Process Mining Discovery Algorithms Evaluation. In C. Di Francescomarino, A. Burattin, C. Janiesch, & S. Sadiq (Eds.), Business Process Management Forum (pp. 163–177). Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-41623-1_10

Djordjevic, M., Djordjevic, A., Klochkova, E., & Misic, M. (2022). Application of Modern Digital Systems and Approaches to Business Process Management. SUSTAINABILITY, 14(3). https://doi.org/10.3390/su14031697

Dumas, M., La Rosa, M., Mendling, J., & Reijers, H. A. (2018). Fundamentals of Business Process Management. Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-662-56509-4

E. Guevara-Rivera, R. Osorno-Hinojosa, & V. H. Zaldívar-Carrillo. (2020). A Simulation Methodology for Circular Economy Implementation. 2020 10th International Conference on Advanced Computer Information Technologies (ACIT), 43–48. https://doi.org/10.1109/ACIT49673.2020.9208839

Elkington, J. (1997). Partnerships from cannibals with forks: The triple bottom line of 21st-century business. Environmental Quality Management, 8(1), 37–51. https://doi.org/10.1002/tqem.3310080106

Fereday, J., & Muir-Cochrane, E. (2006). Demonstrating Rigor Using Thematic Analysis: A Hybrid Approach of Inductive and Deductive Coding and Theme Development. International Journal of Qualitative Methods, 5(1), 80–92. https://doi.org/10.1177/160940690600500107

Fleaca, E., Fleaca, B., & Maiduc, S. (2018). Aligning Strategy with Sustainable Development Goals (SDGs): Process Scoping Diagram for Entrepreneurial Higher Education Institutions (HEIs). SUSTAINABILITY, 10(4). https://doi.org/10.3390/su10041032

Folke, C., Biggs, R., Norström, A. V., Reyers, B., & Rockström, J. (2016). Social-ecological resilience and biosphere-based sustainability science. Ecology and Society, 21(3). https://www.jstor.org/stable/26269981

Fritsch, A., von Hammerstein, J., Schreiber, C., Betz, S., & Oberweis, A. (2022). Pathways to Greener Pastures: Research Opportunities to Integrate Life Cycle Assessment and Sustainable Business Process Management Based on a Systematic Tertiary Literature Review. Sustainability, 14(18), Article 18. https://doi.org/10.3390/su141811164

Gallotta, B., Kolelas, V., Garza-Reyes, J. A., Anosike, A., & Kumar, V. (2017). Using BPM to improve sustainability in biomass generation.

Gayialis, S., Kechagias, E., Papadopoulos, G., & Panayiotou, N. (2022). A Business Process Reference Model for the Development of a Wine Traceability System. SUSTAINABILITY, 14(18). https://doi.org/10.3390/su141811687

Ghose, A., Hoesch-Klohe, K., Hinsche, L., & Le, L.-S. (2010). GREEN BUSINESS PROCESS MANAGEMENT: A RESEARCH AGENDA. Australasian Journal of Information Systems, 16(2), Article 2. https://doi.org/10.3127/ajis.v16i2.597

Gohar, S. R. (2019). Visualization of Environmental Performance Indicators (EPI) on Business Process Models: A hospitality industry perspective.

Gohar, S. R., & Indulska, M. (2020). Environmental Sustainability through Green Business Process Management. AUSTRALASIAN JOURNAL OF INFORMATION SYSTEMS, 24. https://doi.org/10.3127/ajis.v24i0.2057

Graves, N., Koren, I., & van der Aalst, W. M. P. (2023). ReThink Your Processes! A Review of Process Mining for Sustainability. 2023 International Conference on ICT for Sustainability (ICT4S), 164–175. https://doi.org/10.1109/ICT4S58814.2023.00025

Greenland, S. J., Saleem, M., Misra, R., Nguyen, N., & Mason, J. (2023). Reducing SDG complexity and informing environmental management education via an empirical six-dimensional model of sustainable development. Journal of Environmental Management, 344, 118328. https://doi.org/10.1016/j.jenvman.2023.118328

Hehnle, P., Behrendt, M., Weinbrecht, L., & Corea, C. (2024). Carbon-Aware Process Execution for Green Business Process Management: Proceedings of the 26th International Conference on Enterprise Information Systems, 659–666. https://doi.org/10.5220/0012557100003690

Heras-Saizarbitoria, I., Urbieta, L., & Boiral, O. (2022). Organizations' engagement with sustainable development goals: From cherry-picking to SDG-washing? Corporate Social Responsibility and Environmental Management, 29(2), 316–328. https://doi.org/10.1002/csr.2202

Hernández González, A., Calero, C., Pérez Parra, D., & Mancebo, J. (2019). Approaching Green BPM characterisation. Journal of Software: Evolution and Process, 31(2), e2145. https://doi.org/10.1002/smr.2145

Houy, C., Reiter, M., Fettke, P., Loos, P., Hoesch-Klohe, K., & Ghose, A. (2012). Advancing Business Process Technology for Humanity: Opportunities and Challenges of Green BPM for Sustainable Business Activities. In J. vom Brocke, S. Seidel, & J. Recker (Eds.), Green Business Process Management: Towards the Sustainable Enterprise (pp. 75–92). Springer. https://doi.org/10.1007/978-3-642-27488-6_5

Ivana, D., Drăgan, M., Maftei, M., Götze, U., & Metz, D. (2022). Study of Knowledge Management Impact on Sustainable Higher Education Institutions: A Business Process Modelling Approach. 85–101. https://doi.org/10.1007/978-3-030-82751-9_6

Kitchenham, B. (2004). Procedures for Performing Systematic Reviews. Keele, UK, Keele Univ., 33.

Langella, I., & Dao, V. (2011). From green to sustainability: Information Technology and an integrated sustainability framework. The Journal of Strategic Information Systems. https://www.academia.edu/19369728/From_green_to_sustainability_Information_Technology_and_an_integrated_sustainability_framework

Larsch, S., Betz, S., Duboc, L., Magdaleno, A. M., & Bomfim, C. (2017). Integrating Sustainability Aspects in Business Process Management. In M. Dumas & M. Fantinato (Eds.), Business Process Management Workshops (pp. 403–415). Springer International Publishing. https://doi.org/10.1007/978-3-319-58457-7_29

Loos, P., Nebel, W., Marx Gómez, J., Hasan, H., Watson, R., Brocke, J. vom, Seidel, S., & Recker, J. (2011). Green IT: A Matter of Business and Information Systems Engineering? Business & Information Systems Engineering, 3, 245–252. https://doi.org/10.1007/s12599-011-0165-5

Looy, A. V., Backer, M. D., & Poels, G. (2014). A conceptual framework and classification of capability areas for business process maturity. Enterprise Information Systems, 8(2), 188–224. https://doi.org/10.1080/17517575.2012.688222

Lübbecke, P., Fettke, P., & Loos, P. (2016). Towards Ecological Workflow Patterns as an Instrument to Optimize Business Processes with Respect to Ecological Goals (T. Bui & R. Sprague, Eds.; WOS:000432711501019; pp. 1049–1058). https://doi.org/10.1109/HICSS.2016.134

Lübbecke, P., Fettke, P., & Loos, P. (2017). Sustainability Patterns for the Improvement of IT-Related Business Processes with Regard to Ecological Goals (M. Dumas & M. Fantinato, Eds.; WOS:000724486700034; Vol. 281, pp. 428–439). https://doi.org/10.1007/978-3-319-58457-7_31

Lübbecke, P., Goswami, A., & Fettke, P. (2018). A method for Ecological Process Optimization based on Compliance Checking (H. Proper, S. Strecker, & C. Huemer, Eds.; WOS:000502540800013; pp. 119–128). https://doi.org/10.1109/CBI.2018.00022

Maciel, J. (2017). The Core Capabilities of Green Business Process Management – A Literature Review.

Madonsela, N., Mukwakungu, S., & Mbohwa, C. (2017). CONTINUOUS INNOVATION AS FUNDAMENTAL ENABLER FOR SUSTAINABLE BUSINESS PRACTICES (G. Seliger, H. Kohl, & G. Oosthuizen, Eds.; WOS:000400857500035; Vol. 8, pp. 278–283). https://doi.org/10.1016/j.promfg.2017.02.035

Magdaleno, A., Duboc, L., & Betz, S. (2016). How to Incorporate Sustainability into Business Process Management Lifecycle? https://doi.org/10.1007/978-3-319-58457-7_32

Mangialardi, G., Corallo, A., Lazoi, M., & Scozzi, B. (2022). Process View to Innovate the Management of the Social Housing System: A Multiple Case Study. SUSTAINABILITY, 14(14). https://doi.org/10.3390/su14148294

Mangukiya, R. D., & Sklarew, D. M. (2023). Analyzing three pillars of sustainable development goals at sub-national scales within the USA. World Development Sustainability, 2, 100058. https://doi.org/10.1016/j.wds.2023.100058

Mc Loughlin, K., Lewis, K., Lascelles, D., & Nudurupati, S. (2023). Sustainability in supply chains: Reappraising business process management. PRODUCTION PLANNING & CONTROL, 34(1), 19–52. https://doi.org/10.1080/09537287.2021.1884764

Mihova, T., Nikolova-Alexieva, V., Angelova, M., & IEEE. (2018). Factors Affecting Business Process Management in the Bulgarian Enterprises to Achieve Sustainable Development (WOS:000458755800003). 2018 INTERNATIONAL CONFERENCE ON HIGH TECHNOLOGY FOR SUSTAINABLE DEVELOPMENT (HITECH).

Mishra, M., Desul, S., Santos, C. A. G., Mishra, S. K., Kamal, A. H. M., Goswami, S., Kalumba, A. M., Biswal, R., Da Silva, R. M., Dos Santos, C. A. C., & Baral, K. (2023). A bibliometric analysis of sustainable development goals (SDGs): A review of progress, challenges, and opportunities. Environment, Development and Sustainability, 26(5), 11101–11143. https://doi.org/10.1007/s10668-023-03225-w

Munsamy, M., Telukdarie, A., & Fresner, J. (2019). Business process centric energy modelling. BUSINESS PROCESS MANAGEMENT JOURNAL, 25(7), 1867–1890. https://doi.org/10.1108/BPMJ-08-2018-0217

Myszewski, J. (2016). On sustainable development of organization. BUSINESS PROCESS MANAGEMENT JOURNAL, 22(5), 993–1008. https://doi.org/10.1108/BPMJ-02-2016-0033

Nowak, A., Binz, T., Fehling, C., Kopp, O., Leymann, F., & Wagner, S. (2012). Pattern-driven Green Adaptation of Process-based Applications and their Runtime Infrastructure. Computing, 94. https://doi.org/10.1007/s00607-012-0188-x

Nowak, A., Leymann, F., Schumm, D., & Wetzstein, B. (2011). An Architecture and Methodology for a Four-Phased Approach to Green Business Process Reengineering. In D. Kranzlmüller & A. M. Toja (Eds.), Information and Communication on Technology for the Fight against Global Warming (pp. 150–164). Springer. https://doi.org/10.1007/978-3-642-23447-7_14

Oncioiu, I., Capusneanu, S., Constantin, D., Türkes, M., Topor, D., Bîlcan, F., & Petrescu, A. (2019). Improving the Performance of Entities in the Mining Industry by Optimizing Green Business Processes and Emission Inventories. PROCESSES, 7(8). https://doi.org/10.3390/pr7080543

Opitz, N., Krüp, H., & Kolbe, L. M. (2014a). ENVIRONMENTALLY SUSTAINABLE BUSINESS PROCESS MANAGEMENT – DEVELOPING A GREEN BPM READINESS MODEL.

Opitz, N., Krüp, H., & Kolbe, L. M. (2014b). Green Business Process Management – A Definition and Research Framework. 2014 47th Hawaii International Conference on System Sciences, 3808–3817. https://doi.org/10.1109/HICSS.2014.473

Palmi, P., Esposito, M., & Prete, M. I. (2021). Change in Perspectives in Cultural Tourism: A Sustainable Managerial Model for Cultural Thematic Routes Creating Territorial Value. In Contributions to Management Science (pp. 199–223). https://doi.org/10.1007/978-3-030-65687-4_10

Pedersen, C. S. (2018). The UN Sustainable Development Goals (SDGs) are a Great Gift to Business! Procedia CIRP, 69, 21–24. https://doi.org/10.1016/j.procir.2018.01.003

Pengue, W., Gemmill-Herren, B., Balázs, B., Ortega, E., Viglizzo, E., Acevedo, F., Díaz, D., Díaz de Astarloa, D., Rosa, F., Garibaldi, L., Giampietro, M., Goldberg, A., Koshla, A., & Westhoek, H. (2018). Chapter III. Eco-Agri-Food Systems: Today’s realities and tomorrow’s challenges.

Piotrowicz, W. (2011). Monitoring Performance. In R. Cuthbertson, B. Cetinkaya, G. Ewer, T. Klaas-Wissing, W. Piotrowicz, & C. Tyssen (Eds.), Sustainable Supply Chain Management: Practical Ideas for Moving Towards Best Practice (pp. 57–80). Springer. https://doi.org/10.1007/978-3-642-12023-7_3

Plattfaut, R. (2022). On the Importance of Project Management Capabilities for Sustainable Business Process Management. SUSTAINABILITY, 14(13). https://doi.org/10.3390/su14137612

Rodríguez, C., Dávila, D. A., & Quintero, N. (2021). Application of the BPM Life Cycle in the Post-harvest Process in a Company in the Floricultural Sector. In M. T. Castañeda Galvis, J. Nuñez Rodriguez, M. del C. Pérez Ordoñez, & M. Villa Marulanda (Eds.), Proceedings of the International Congress of Industrial Engineering (ICIE2019) (pp. 141–148). Springer International Publishing. https://doi.org/10.1007/978-3-030-49370-7_15

Rosemann, M. (2006). Potential pitfalls of process modeling: Part A. Business Process Management Journal, 12, 377–384. https://doi.org/10.1108/14637150610668024

Rosemann, M., & Brocke, J. vom. (2010). The Six Core Elements of Business Process Management. In Handbook on Business Process Management (Vol. 1, pp. 107–122). https://doi.org/10.1007/978-3-642-00416-2_5

Rosemann, M., & vom Brocke, J. (2015). The Six Core Elements of Business Process Management. In J. vom Brocke & M. Rosemann (Eds.), Handbook on Business Process Management 1: Introduction, Methods, and Information Systems (pp. 105–122). Springer. https://doi.org/10.1007/978-3-642-45100-3_5

Rozman, T., & Riel, A. (2015). Achieving Sustainable Development by Integrating It into the Business Process Management System. 247–259. https://doi.org/10.1007/978-3-319-24647-5_20

S. Signore, A. Rimini, & M. Lazoi. (2021). Evaluating Process Maturity in creative and cultural Industries. 2021 IEEE International Conference on Engineering, Technology and Innovation (ICE/ITMC), 1–7. https://doi.org/10.1109/ICE/ITMC52061.2021.9570242

Sachs, J. D. (2012). From Millennium Development Goals to Sustainable Development Goals. The Lancet, 379(9832), 2206–2211. https://doi.org/10.1016/S0140-6736(12)60685-0

Schoormann, T., Behrens, D., & Knackstedt, R. (2017). Sustainability in Business Process Models: A Taxonomy-Driven Approach to Synthesize Knowledge and Structure the Field.

Schoormann, T., Kutzner, K., Pape, S., & Knackstedt, R. (2019). Elevating Social Sustainability in Business Processes: A Pattern-Based Approach.

Seidel, S., Bharati, P., Fridgen, G., Watson, R., Albizri, A., Boudreau, M.-C., Butler, T., Chandra Kruse, L., Guzman, I., Karsten, H., Lee, H., Melville, N., Rush, D., Toland, J., & Watts, S. (2017). The Sustainability Imperative in Information Systems Research. Communications of the Association for Information Systems, 40. https://doi.org/10.17705/1CAIS.04003

Seidel, S., Brocke, J. vom, & Recker, J. (2011). Call for action: Investigating the role of business process management in green IS. Sprouts: Working Papers on Information Systems, 11.

Seidel, S., Recker, J., & Brocke, J. vom. (2012). Green Business Process Management. Green Business Process Management, 3–13. https://doi.org/10.1007/978-3-642-27488-6_1

Sellitto, M. (2018). Assessment of the effectiveness of green practices in the management of two supply chains. BUSINESS PROCESS MANAGEMENT JOURNAL, 24(1), 23–48. https://doi.org/10.1108/BPMJ-03-2016-0067

Skarlat, O., Hoenisch, P., & Dustdar, S. (2016). On Energy Efficiency of BPM Enactment in the Cloud (Vol. 256, p. 500). https://doi.org/10.1007/978-3-319-42887-1_39

Sohns, T., Aysolmaz, B., Figge, L., & Joshi, A. (2023). Green business process management for business sustainability: A case study of manufacturing small and medium-sized enterprises (SMEs) from Germany. JOURNAL OF CLEANER PRODUCTION, 401. https://doi.org/10.1016/j.jclepro.2023.136667

Soler, J. A. P., Delgado, F. M., García, M. N., & Sánchez, Y. A. (2024). Sustainability Management Framework: Case Study of a Cuban IT Project Organization. In P. Y. Piñero Pérez, J. Kacprzyk, R. Bello Pérez, & I. P. Pupo (Eds.), Computational Intelligence in Engineering and

Project Management (pp. 309–326). Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-50495-2_12

Stojanovic, D., Simeunovic, B., Tomasevic, I., & Jovanovic, I. (2020). The Influence of Business Process Prioritization on Success of BPM adoption (S. Drezgic, S. Zikovic, & M. Tomljanovic, Eds.; WOS:000589579700014; pp. 235–258).

Strimovskaya, A., & Barykin, S. (2023). A multidimensional approach to the resource allocation problem (RAP) through the prism of industrial information integration (III). JOURNAL OF INDUSTRIAL INFORMATION INTEGRATION, 34. https://doi.org/10.1016/j.jii.2023.100473

Sulis, E. (2023). Agent-Based Simulations and Process Mining: A Green BPM Case Study. 337–344. https://doi.org/10.1007/978-3-031-34920-1_27

Szennay, Á., Szigeti, C., Kovács, N., & Szabó, D. R. (2019). Through the Blurry Looking Glass—SDGs in the GRI Reports. Resources, 8(2), Article 2. https://doi.org/10.3390/resources8020101

The Brundtland Report: "Our Common Future" on JSTOR. (1987). https://www.jstor.org/stable/45353161

The SDGs wedding cake. (2016, June 14). [Text]. https://www.stockholmresilience.org/research/research-news/2016-06-14-the-sdgs-wedding-cake.html

Toymentseva, I. A., Chichkina, V. D., & Denisova, O. N. (2023). Modeling Sustainable Development of Industrial Enterprise in the Context of Digitalization. 378 LNCE, 58–65. https://doi.org/10.1007/978-3-031-38122-5_9

United Nations General Assembly. (2015). Transforming our World: The 2030 Agenda for Sustainable Development. https://sustainabledevelopment.un.org/post2015/transformingourworld/publication

Van Der Aalst, W. M. P. (2022). Process Mining: A 360 Degree Overview. In W. M. P. Van Der Aalst & J. Carmona (Eds.), Process Mining Handbook (Vol. 448, pp. 3–34). Springer International Publishing. https://doi.org/10.1007/978-3-031-08848-3_1

Van Looy, A., Backer, M., & Poels, G. (2012). A conceptual framework and classification of capability areas for business process maturity. Enterprise Information Systems - ENTERP INF SYST, 8, 1–37. https://doi.org/10.1080/17517575.2012.688222

Watson, R. T., Boudreau, M.-C., & Chen, A. J. (2010). Information Systems and Environmentally Sustainable Development: Energy Informatics and New Directions for the IS Community. MIS Quarterly, 34(1), 23–38. https://doi.org/10.2307/20721413

Webster, J., & Watson, R. T. (2002). Analyzing the Past to Prepare for the Future: Writing a Literature Review. MIS Quarterly, 26(2), xiii–xxiii.

Weske, M. (2019). Business Process Management: Concepts, Languages, Architectures. Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-662-59432-2

Wu, L., Yi, X., Hu, K., Lyulyov, O., & Pimonenko, T. (2024). The effect of ESG performance on corporate green innovation. BUSINESS PROCESS MANAGEMENT JOURNAL. https://doi.org/10.1108/BPMJ-04-2023-0237

Xiao, Y., & Watson, M. (2019). Guidance on Conducting a Systematic Literature Review. Journal of Planning Education and Research, 39(1), 93–112. https://doi.org/10.1177/0739456X17723971

Yanamandra, R., Abidi, N., Srivastava, R., Kukunuru, S., & Alzoubi, H. M. (2023). Approaching Quality 4.0: The Digital Process Management as a Competitive Advantage. 2nd International Conference on Business Analytics for Technology and Security, ICBATS 2023. https://doi.org/10.1109/ICBATS57792.2023.10111453

Yanine, F., & Campos, Z. (2023). Sustaining Business Performance Management: An Operational Framework. 221, 25–32. https://doi.org/10.1016/j.procs.2023.07.004

Zhao, X., Cho, N., Yongchareon, S., Shen, J., Dewan, S., & IEEE. (2018). Enabling Intelligent Business Processes with Context Awareness (WOS:000501731200020). 153–160. https://doi.org/10.1109/SCC.2018.00027