



A conceptual model and supporting approach for EU taxonomy alignment with green BPM

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Abstract

Increasingly, companies are obliged and incentivized through regulations to consider the impact of their business processes on the environment, in order to promote *sustainable* business practices. In particular, the *EU Taxonomy for Sustainable Activities* outlines criteria for when business practices contribute towards a sustainable future. However, it is unclear in how far existing methods for analysing and improving business practices, in particular those of the disciplines of *Business Process Management* (BPM) and *Green BPM* (i.e. a BPM variant focussing on environmental sustainability) can make use of those criteria and their underlying concepts. Therefore, we propose a conceptual model that combines concepts of the EU Taxonomy and Green BPM and clarifies the relationship between the two domains. This conceptual model is intended to provide clarity to Green BPM researchers and practitioners, and EU Taxonomy experts, in order to bridge the gap between the two domains and to operationalize the EU Taxonomy with Green BPM approaches. For further guidance regarding this operationalization, we also develop an approach to support the conceptual model's application. We evaluate the semantics and pragmatics of our conceptual model. We find the aligned conceptual model to be semantically feasibly valid and complete; via an illustrative example and a focus group evaluation with Green BPM and EU Taxonomy experts we also find that both the aligned model and the supporting approach provide utility to their intended audiences.

Keywords Green BPM · EU Taxonomy · Conceptual model · Sustainability

1 Introduction

Organizations and businesses, particularly in industrial sectors, usually consume natural resources and cause emissions and waste, contributing to resource scarcity, climate change

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and the pollution of habitats and ecosystems. Global supply chains extend these environmental impacts between regions [1, 2]. In response to these environmental challenges, the notion of *sustainability* outlines adopting practices that serve to “[meet] the needs of the present without compromising the ability of future generations to meet their own needs” as a solution [3, 4]. Recognizing the importance of this, bodies such as the *European Union* (EU) have developed regulatory frameworks and incentives to help and to encourage companies to integrate sustainability into their business practices and strategies. One of the frameworks is the EU's *Taxonomy for Sustainable Activities*, subsequently referred to as *EU Taxonomy* [5, 6]. An overarching goal of the EU Taxonomy lies in providing clear criteria for when business practices contribute to sustainability objectives, and when not [7].

As a relevant viewpoint for managing and improving business practices, specifically business processes, *Business Process Management* (BPM) is a discipline commonly used within organizations. The underlying notion of BPM is that each product or service an organization offers results from

various activities performed in a coordinated manner, i.e. a business process [8]. *Green BPM* extends this concept by integrating environmental sustainability into all phases of the process management lifecycle [9, 10], in order for BPM to contribute to sustainable business practices [11]. Even though there are Green BPM approaches that can quantify the environmental impact of business processes [12, 13] and that can help in determining and executing variants that are less environmentally impactful [14, 15], such approaches offer no clear indication for when a given business process can be categorically considered *sustainable*. For example, existing Green BPM approaches may help to identify and enact a reduction of *Greenhouse Gas* (GHG) emissions for a business process, and yet it remains unclear whether that reduction makes the business process an environmentally *sustainable* one, or only *less unsustainable*. Here, clear criteria for when business processes can be considered sustainable would be helpful—criteria, which might be offered by the EU Taxonomy.

However, while the objectives of Green BPM and the EU Taxonomy are in principle compatible with one another, namely contributing to the establishing of sustainable business practices, Green BPM research and practice have not yet structurally integrated concepts of the EU Taxonomy into their considerations of sustainability on a business process level. It remains unclear in how far the EU Taxonomy, its concepts and constraints relate to business processes in the first place, and hence, it is unclear whether they might be applicable for determining—and improving—the environmental sustainability of business processes. In addition, EU Taxonomy alignment is, in practice, assessed and improved largely manually [16, 17], without drawing on various approaches offered by Green BPM that might support doing so by technical or automated means. Treating the two domains separately leaves potential synergies in (1) employing the EU Taxonomy’s criteria for determining when business processes can be considered environmentally sustainable and (2) supporting the assessment and improvement of business practices for the EU Taxonomy by means of Green BPM approaches, unused. Given this, it therefore is prudent to examine in how far the EU Taxonomy aligns with a Green BPM “perspective”. Insights into this alignment will ultimately offer the potential for making business processes more sustainable by providing a structured approach—being Green BPM—for analysing and improving them in light of the EU Taxonomy.

Nonetheless, integrating Green BPM with the EU Taxonomy is challenging due to different points of view: BPM, the foundation upon which Green BPM is built, is concerned with managing activities and processes w.r.t. *business goals* [8], whereas the EU Taxonomy formulates criteria for when business practices contribute towards specific

sustainability goals [7].¹ Bridging this gap by conceptually linking Green BPM approaches to the EU Taxonomy would contribute to help organizations in increasing regulatory compliance and meeting potential reporting obligations on the one hand, and in implementing sustainable business practices on the other [7]. Further, it would allow Green BPM practitioners, researchers, and vendors to orient Green BPM approaches towards the EU Taxonomy, which constitutes a novel and practically relevant angle for integrating a notion of sustainability into the management of business processes. In this study, we therefore explore how, conceptually, Green BPM and the EU Taxonomy could be aligned and jointly used to assess and improve business processes w.r.t. sustainability criteria; in doing so, we aim to address the following research questions (RQs):

RQ1: How do concepts of the EU Taxonomy and Green BPM align?

RQ2: How can this alignment be used for applying Green BPM techniques in light of the EU Taxonomy?

To achieve this, we propose and develop two artefacts: First, a *conceptual model* that explicates the conceptual relationships between Green BPM and the EU Taxonomy; second, a supporting approach that structures the selection and applicability of Green BPM approaches for making use of the EU Taxonomy’s criteria in particular situations regarding a particular business process. *Jointly*, they illustrate the applicability of Green BPM approaches for assessing and improving the sustainability of business processes according to the EU Taxonomy by *first* making apparent the conceptual alignment between the two domains, and *then* outlining angles for making use of that alignment. This article is based on a previous study, where we first proposed the conceptual model [19]. Here, we expand on it in several ways: We develop a supporting approach to guide the application of Green BPM approaches in light of the conceptual model, provide further details for the model’s development, and extend its evaluation by means of a focus group of research and industry experts. The remainder of this work is organized as follows: In Sect. 2, we provide the necessary background and discuss related work. In Sect. 3, we describe the methodology used to develop the conceptual model. Section 4 presents the main results of our study, which are applied to an illustrative example and evaluated in Sect. 5. Finally, we discuss

¹ Here, one needs to distinguish between the *raison d’être* of business processes, which constitutes their underlying business goal [18], and the various sustainability goals of the EU Taxonomy. While making a contribution to these latter goals can *also* be understood as being part of a business goal, this is not the *primary* reason for the existence of a business process. Inversely, contributing to a sustainability goal does not necessarily bring about a specific service or product. Clearly, the two domains have differing viewpoints on organizational practice.

our findings and conclude the article in Sect. 6, in addition to suggesting directions for future work.

2 Theoretical background

In the following, we summarize the general concept and aims of the EU Taxonomy and provide an overview of existing Green BPM approaches; we also discuss existing work relating to our study.

2.1 EU taxonomy for sustainable activities

The EU Taxonomy is a framework established to promote sustainable *economic activities* (i.e. families of *business processes* involving the production, distribution, or consumption of goods and services [7, 20]) by offering a system for classifying environmentally sustainable practices. It aims to assist investors, businesses, and regulators in determining which economic activities contribute to environmental sustainability. The primary objective of the EU Taxonomy is to aid the EU in its goal of achieving climate neutrality by 2050 [21, 22]. For achieving this objective, the EU Taxonomy is intended to (1) establish clear indicators and criteria to differentiate between sustainable and non-sustainable business practices, thereby preventing *greenwashing*²; (2) motivate businesses to prioritize sustainable practices, and (3) encourage financial investments into companies that contribute to the achievement of sustainability goals [6, 7]. The EU Taxonomy obligates certain companies, particularly “non-financial undertakings”³ that fall under the scope of the *Corporate Sustainability Reporting Directive*, to report key performance indicators (KPIs), or more concretely, the proportion of turnover, capital expenditure (CapEx), and operating expenditure (OpEx) generated with economic activities that can and do fulfil applicable sustainability criteria. However, the EU Taxonomy’s criteria for identifying when certain business practices are sustainable, can also *voluntarily* be made use of by organizations *not* subject to reporting obligations, in order determine in how far their business practices and corresponding business processes contribute to sustainability goals [25].

To classify and identify sustainable activities, the EU Taxonomy uses *Nomenclature of Economic Activities* (NACE) codes, a standard classification system for economic activities within the EU. Each of the around 80 economic activities covered by the EU Taxonomy [21, 26] is assigned one or more NACE codes, which provide a detailed categorization based on the type of activity being performed. These codes

allow businesses and regulators to identify which activities are subject to the sustainability criteria outlined by the EU Taxonomy [27]. Further, the definition of NACE codes and economic activities (see [28]) is closely aligned with the definition of business processes (see [8]) — here, we understand economic activities to provide “families” or “classes” of business processes and business practices [7].

For making a contribution towards sustainability goals, those economic activities that can theoretically do so (i.e. *Taxonomy-eligible* economic activities) must meet four requirements [27]. First, *Substantial Contributions*: Economic activities must significantly contribute to environmental objectives, such as climate change mitigation, adaptation, water and marine resource protection, circular economy transition, pollution prevention, or biodiversity restoration [29]. Second, *Do No Significant Harm* (DNSH): Economic activities must not harm other environmental objectives [30]. Third, *Minimum Safeguards*: Economic activities must adhere to social safeguards, including human rights and ethical practices [31–34]. Fourth, *Technical Screening Criteria*: Economic activities must fulfil specific technical standards to ensure adherence to the requirements above. Notably, Taxonomy-eligible economic activities identified as potentially contributing to environmental objectives become *Taxonomy-aligned* only when all criteria are satisfied [35].

As a particular example, consider the taxonomy-eligible economic activity “Manufacture of batteries” (NACE code C27.2) that is concerned with the business practice of manufacturing various kinds of batteries. We will re-visit a business process belonging to that practice subsequently in Sect. 5.2. For battery manufacturing, the EU Taxonomy imposes several technical screening criteria to determine substantial contributions to the environmental objectives of climate change mitigation and climate change adaption made by the economic activity [25], as well as technical screening criteria for determining whether the economic activity causes significant harm to other objectives. For instance,⁴ depleted batteries must be recycled, certain substances may not be used throughout the manufacturing process, and techniques that support the use of secondary materials should be, if feasible, adopted [25]. If all relevant criteria are fulfilled by the battery manufacturing process, the economic activity is taxonomy-aligned, that is, can be considered sustainable in light of the EU Taxonomy; subsequently, the organization responsible for the economic activity under consideration can report the share of its overall turnover, CapEx, and OpEx generated with this taxonomy-aligned economic activity. However, it is worth noting here that there is a wide

² That is, making misleading claims about environmental performance [23].

³ Meaning organizations that are not financial institutions [24].

⁴ Since these technical screening criteria are lengthy and complex, also referring to constraints provided in regulations external to the EU Taxonomy regulation itself, we cannot go into detail here. In Sect. 5.2, we will provide further summarized criteria.

range of other economic activities covered by the EU Taxonomy, which have their own specific technical screening criteria for determining substantial contributions and significant harm.

In all these requirements, the overall notion of sustainability that the EU Taxonomy embodies is one of *sustainable development* [36]. This notion holds that “resources should be managed to be available for future generations, natural and human capital are interchangeable and nature should be cared about only to the extent considered as human interests” and “that humankind has a special and almost detached relationship with nature and is only interested in the instrumental or utilitarian value attached to an ecosystem” [37]. For a more in-depth description of the EU Taxonomy, we refer interested readers to a previous study of ours [7].

2.2 Green BPM

An area of BPM that is well-situated to integrate concepts of the EU Taxonomy is Green BPM: This subfield has emerged as a response to an increasing awareness of environmental concerns and a need to integrate a perspective on environmental sustainability into the management of business processes [11, 38]. To this end, Green BPM offers various techniques and approaches to manage and improve business processes regarding their environmental performance [9]:

- (1) *Modelling* approaches include modelling guidelines for modelling business processes that can be optimized for the environmental impact of corresponding process executions [39], or extended notions for representing environmental impact or resource consumption in process models [9, 10]. For example, Recker et al. [12, 40], Wesumperuma et al. [41] provide extended notions for representing environmental impact in process models, commonly in terms of GHG emissions or resource consumption; Hoesch-Klohe et al. [14] propose an approach for modelling resources used in activity executions and deriving their environmental impact in terms of GHG emissions.
- (2) *Deployment* approaches include mechanisms for measuring and controlling emissions of business processes [9, 10]. For example, Nowak et al. [15] describe how environmental impact in terms of GHG emissions, water usage and energy consumption can be measured or estimated during process execution on an activity level and highlighted in a process model, so that potential process alternatives can be derived. Costache et al. [42] propose a set of guidelines for using process mining to extract GHG emission data of production processes.
- (3) *Optimization* approaches encompass mechanisms for benchmarking process re-designs for their environmental impact [9, 10]. Examples include Wesumperuma et al. [43], who propose the use of simulation-based techniques to determine how activity timings change GHG emissions and financial costs of a business process based on energy consumption, and Hoesch-Klohe et al. [14] who propose a semi-automated approach based on process patterns and modelled resources to re-design process for reducing their carbon emissions.
- (4) *Management* approaches include extensions of the business process lifecycle with concepts of sustainability [10]. For example, Opitz et al. [44], Jakobi et al. [45] propose variants of a Green BPM lifecycle; Ghose et al. [46] propose an approach for “carbon-aware process management”. Further, in a previous study, we have proposed the applicability of *compliance monitoring*, in extension to existing deployment approaches, with which various constraints of the EU Taxonomy might be monitored for violations during business process execution [7].

2.3 Related work

In this article, we investigate to what extent and where concretely the EU Taxonomy aligns with Green BPM concepts, to outline fruitful avenues for operationalizing constraints from the EU Taxonomy with Green BPM approaches. In that sense, our study is related to other contributions that deal with conceptual overviews of the (Green) BPM “perspective” on organizations and processes or propose conceptual integrations of sustainability into BPM or organizational practice.

Several studies formally capture entities that make up business processes and organizations from the BPM discipline’s standpoint. For example, Annane et al. [47] present a *BPMN-based ontology* (BBO) for business representation, aiming to provide a formal and structured representation of business processes using ontologies to improve the analysis, simulation, and automation of business processes. Vom Brocke et al. [48] emphasize the role of context in BPM initiatives, which influences through various factors the concrete application of BPM practices; they also propose a framework to systematically identify and analyse them. Andree and Pufahl [49] address the role of context in business process redesign by presenting a metamodel that captures relevant contextual information to assess change operations. Rosemann et al. [50] focus on addressing the flexibility of business process; they propose a framework and metamodel for identifying and integrating these contextual factors into business process modelling.

In addition, various studies have engaged with integrating sustainability concepts into business practice, particularly in the research stream of Green BPM [9, 10]. However, only some studies, which we found via a hermeneutic literature search [51], provide conceptual models of the entities and relationships involved in this. For example, Medini et al. [52] provide a metamodel that combines components of

enterprises and their processes with entities regarding sustainability. Reiter et al. [53] present a conceptual model and approach for integrating IT components, applications, and business processes, to support reducing the energy consumption of business processes. Further, Larsch et al. [54] present a sequential approach for process analysis in Green BPM and provide a metamodel that relates business processes with sustainability concepts. Finally, while not providing a conceptual model, Roohy Gohar and Indulska [38] describe concepts and indicators for incorporating environmental sustainability into BPM. In a previous study [13], we provide an approach for data-driven holistic assessments of the environmental impact of business processes; most relevant here being a metamodel that provides a conceptual overview of processes, activities, instances thereof, and instantiations of environmental impact.

In a similar vein as the previous group of related work, our study converses with contributions that conceptually address the complexities of multiple reporting standards and the ambiguity of informal textual descriptions of sustainability indicators. As a particular example, Zhou and Perzylo [55] propose the *OntoSustain* model and provide a conceptual overview of how small and medium-sized enterprises can benefit in navigating sustainability reporting challenges. While also providing a conceptual model, their contribution does not directly align with BPM practices, nor the EU Taxonomy and the concept of EU Taxonomy alignment.

Currently, there are only initial and exploratory approaches that investigate in how far companies can be supported in aligning Green BPM approaches and practices with sustainability regulations, without clear and generalized guidance [56]; only some attention has been paid to understand how business processes can be viewed from the EU Taxonomy perspective: In a previous study [7], we investigated whether the constraints of the EU Taxonomy could be used for regulatory compliance monitoring with process mining techniques. What is still missing, however, is a generalized notion of the conceptual alignment between Green BPM and the EU Taxonomy, and how Green BPM approaches can be made use of in view of that alignment. Although existing contributions and their conceptualizations of sustainability reporting or business processes (e.g. [47, 55]) can provide a point of departure, the specific alignment of Green BPM with the EU Taxonomy remains unaddressed. We therefore see the need to provide a conceptual foundation for investigating and using this relation.

3 Research method

In this article, our overall objective is to support the use of Green BPM techniques for operationalizing the EU Taxonomy.

To address the research problem and research questions outlined above, the artefacts developed herein should jointly address the following *solution objectives* (SOs):

- SO1: Conceptualize the alignment between the EU Taxonomy and Green BPM
- SO1: Guide the use of Green BPM approaches for analysing and improving business processes in view of the EU Taxonomy

To meet these objectives, we embed methods for *Conceptual Modelling* [57] in a *Design Science Research* (DSR) methodology [58]. DSR is concerned with addressing practical problems through constructing and evaluating useful *artefacts*, thereby contributing to knowledge of the problem and solution domains [59, 60]. Such artefacts range from instantiations of novel software systems to conceptual frameworks and methods to mature design theories [60]. Various disciplines, from computer science and software engineering, to BPM and IS research, recognize DSR as a legitimate research paradigm [61, 62]; hence, we make use of it in this article for grounding our research approach. As the first *artefact*, we develop the *aligned conceptual model*, which serves to conceptualize the alignment of EU Taxonomy and Green BPM. Then, as the second *artefact*, we develop a *decision tree* as a supporting approach for applying Green BPM approaches. Subsequently, we first elaborate further on the use of DSR in this article. Then, we expand on the methods used for developing the individual artefacts.

3.1 Design science research

Figure 1 outlines the process of DSR and how it is applied in this article. Overall, we follow Peffers et al.'s *Design Science Research Methodology* [58] as the overarching research method.⁵ In Sect. 1, we have *identified the problem* investigated in this article, and *motivated* the need for addressing it. Building on Sects. 1 and 2, we have *defined* two *solution objectives* SO1 and SO2 to be addressed jointly by the artefacts developed herein. The *design and development* of the artefacts is explicated in the remainder of Sect. 3.

In a first DSR iteration, the aligned conceptual model representing the alignment between Green BPM and the EU Taxonomy was developed based on a final thesis conducted at the Technical University of Munich (TUM). The conceptual model resulting from this first iteration was *formatively*

⁵ We have chosen this particular DSR methodology because it holds that artefacts produced by design science can be both technical instantiations and more abstract constructs, models, or methods [58, 63], which fits to the nature of the solution objectives SO1 and SO2 which answers to RQ1 and RQ2 should fulfil.

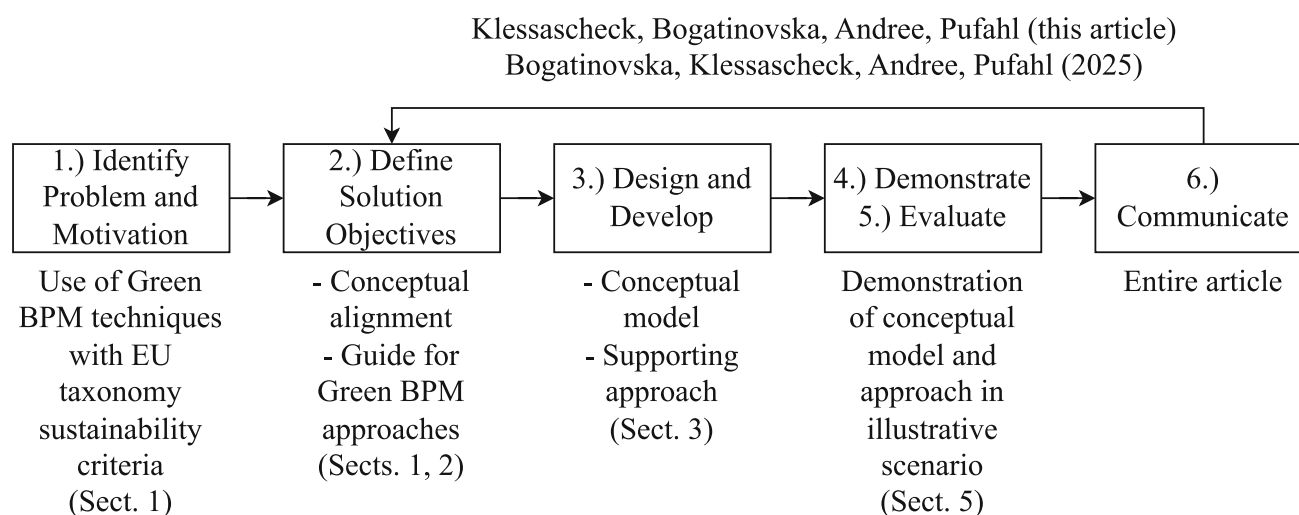


Fig. 1 Methodology of design science research and its application in this article, adapted from [58]

evaluated in an artificial setting [64, 65] and communicated in a conference publication [19].

In a second iteration, represented by this article, we identified the need for supporting the application of Green BPM approaches and developed guidance for this. The supporting approach and conceptual model were jointly evaluated in a *summative, ex-post* evaluation [64], both drawing on an artificial setting and empirical evidence via *focus group sessions* [66, 67].

In Sect. 3.2, we elaborate on the aligned conceptual model's development. Then, in Sect. 3.3, we describe how we developed additional support for applying the aligned conceptual model. In Sect. 4, we present each of the two artefacts in turn. Subsequently, in Sect. 5, we *demonstrate* the artefacts by applying them in an illustrative scenario; we also jointly *evaluate* them for their *utility* based on the demonstration and provide insights from focus group sessions into their utility, following [68]. Finally, this entire article represents the concluding *communication* step of DSR.

3.2 Conceptual model development

So far, Green BPM and the EU Taxonomy have largely been treated separately. To bridge the gap between these domains and their concepts, we develop an *aligned conceptual model* in the following, thereby integrating both domains and identifying common concepts. Here, providing a model that conceptualizes the overlap of Green BPM and the EU Taxonomy is in line with the overall purpose of conceptual models: They are intended to represent conceptualisations of a domain of interest in a way that supports communication, problem-solving, and understanding [69]. For the joint representation of Green BPM and the EU Taxonomy, we adopt the methodological guidelines of Naeem et al. [57]; with

these we first construct two independent conceptual models: one for the EU Taxonomy, which captures the regulatory perspective on sustainable economic activities, and one for Green BPM, which reflects process-oriented sustainability concepts. In a second step, we systematically compare both conceptual models in order to identify overlaps and complementarities. Figure 2 provides a graphical overview of our research method.

The research team involved in the conceptual models' development comprised four researchers with complementary areas of expertise. The second author, an informatics student at TUM, carried out the primary analytical work, including the literature review, statement extraction, thematic analysis following Naeem et al. [57], and initial model construction. The first author, a researcher in information systems with a focus on BPM and sustainability, supervised second author's work and contributed domain expertise in both Green BPM and the EU Taxonomy drawing on his prior work on investigating the EU Taxonomy's constraints for regulatory compliance monitoring with process mining techniques [7]. The third author, a researcher with expertise in BPM and conceptual modelling, contributed methodological expertise, particularly regarding the application of conceptual modelling methods and evaluation guidelines, as well as feedback on the model construction and evaluation. The fourth author, a senior researcher in BPM, provided guidance on the overall research design and the framing of the study and its contribution within the overarching BPM field.

Throughout the first DSR iteration, which lasted from May 2024 to March 2025, we held regular discussion sessions in which intermediate results, including extracted statements, proposed codes, emerging themes, and draft model versions, were reviewed. In particular, the second author presented her coding and thematic analysis results in these sessions,

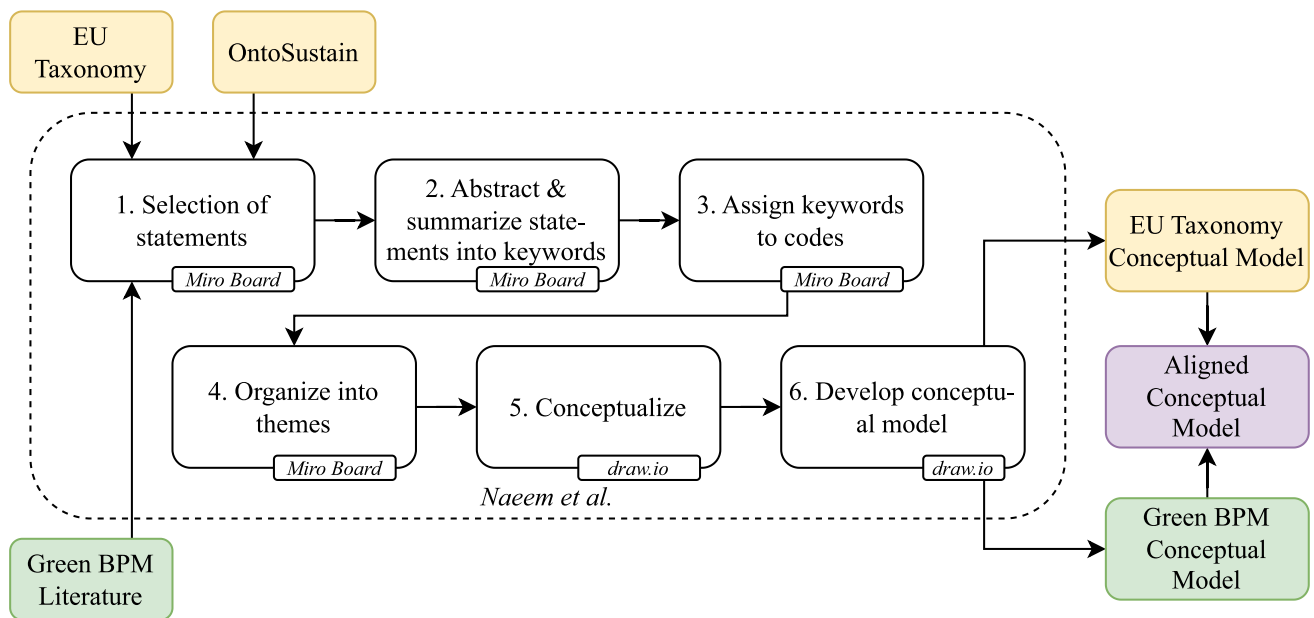


Fig. 2 Methodological overview of the development of the aligned conceptual model. For clarity, iterations in the model development are not shown here

which were then independently re-examined and assessed by the first and third authors drawing on their respective expertise. Where disagreements or ambiguities arose, for instance, regarding whether a particular concept belonged to one domain or both, or whether a code adequately captured the intent of an extracted statement, these were resolved through deliberation among the team until consensus was reached. Decisions regarding the inclusion or exclusion of specific concepts, the assignment of codes to statements, and the structuring of themes into a conceptual model were thus made collaboratively. This was done in order to mitigate the subjectivity inherent in interpretive steps such as statement selection, coding, and theme identification [57] and to reduce the risk of the resulting models being unduly shaped by any single researcher's assumptions.

To ensure methodological clarity, we briefly elaborate on the key concepts used in our thematic analysis and conceptual model construction following Naeem et al. [57], and how they relate to the resulting conceptual models. The process, also illustrated in Figs. 3 and 4, proceeded through several stages. First, we manually selected relevant *statements* from source material, being the EU Taxonomy regulation and its delegated acts, as well as Green BPM literature. From these statements, we manually extracted *keywords*, that is, salient terms or short phrases that capture the core content of a statement [57]. These keywords were then manually abstracted into *codes*, which represent higher-level analytical categories that group related keywords under a common label reflecting an entity or concern of the respective domain [57, 59]. Codes were subsequently manually organized into *themes*, which

capture broader conceptual areas that emerged from patterns across multiple codes [57]. For collecting relevant statements manually selected from relevant literature and results from the thematic analyses, we used a *Miro Board*⁶ as a shared, collaborative document, to which the entire research team had access. Finally, in the conceptualization step, themes and their constituent codes were manually translated into *entities and relationships* [57] in two respective class diagrams, forming the basis of the conceptual model. Here, we used *draw.io*,⁷ a freely accessible graph drawing application, for developing and visually representing these diagrams.

In general, we combined inductive and deductive elements in our model construction [57]. On the one hand, the source material itself provided an inherent structure that guided the identification of codes and themes from statements and keywords. The EU Taxonomy regulation, for instance, is organized around environmental objectives, technical screening criteria, and reporting obligations, which naturally informed the codes and themes, and thus structure of the EU Taxonomy conceptual model. Similarly, existing categorizations in the BPM and Green BPM literature, such as established environmental performance indicators [38], served as an analytical lens during coding. On the other hand, the coding process also inductively produced aspects that were not predetermined by these conceptualizations, such as the overlap between resource types across domains or the shared relevance of supply chain considerations in both per-

⁶ <https://miro.com/> [Accessed: 14/07/2026].

⁷ <https://www.drawio.com/> [Accessed: 14/07/2026].

spectives. In this sense, the thematic analysis was guided by the conceptual organization of the source domains while remaining open to emergent patterns arising from the material itself under analysis [57].

For conceptualizing the identified themes and codes, we used *Unified Modeling Language* (UML) class diagrams, since they allow for detailed modelling of relationships between entities. Their usage in conceptual modelling was introduced in [70]. UML has a widespread and standardized nature that ensures clear communication with practitioners, following the *pragmatism* dimension introduced in [69, 71].

In short, we manually create a conceptual model for each domain to determine the relevant concepts, as further described in Sects. 3.2.1 and 3.2.2. By comparing both models, we identify commonalities and differences, merging them into an *aligned conceptual model* as described in Sect. 3.2.3. In the following, we provide an overview of the sources being used for statement selection for each model. Moreover, we explain how the aligned conceptual model was derived.

3.2.1 EU taxonomy model development

Following Naeem et al. [57], we manually extracted relevant statements from the EU Taxonomy regulation [27] by exploring the specific sustainability constraints, technical screening criteria, and compliance requirements and extracting salient statements.

For this extraction step, we used the *EU Taxonomy navigator* [25] and the *EU Taxonomy regulation's text and delegated acts* [27, 29], both describing identification and classification of economic activities aligned with sustainability objectives. In addition, the ontology presented in Zhou and Perzylo [55] was useful for extracting sustainability entities: It captures key sustainability aspects and indicators relevant to corporate reporting, thus helping us in better conceptualizing the sustainability perspective for companies and how sustainability indicators relate to entities of the business domain. However, due to the specific focus of the OntoSustain model on corporate sustainability reporting, it does not deal with all the elements covered by the EU Taxonomy. Therefore, we added further statements directly from the EU Taxonomy regulation [27]. We then arranged the extracted entities into a conceptual model. This conceptual model was iteratively improved with additional relationships between the entities.

Figure 3 illustrates the process of developing the conceptual model for the EU Taxonomy via thematic analysis following Naeem et al. [57]. As an example, we take a statement requiring companies to report on climate-related KPIs, or more concretely, the proportion of turnover, CapEx, and OpEx associated with Taxonomy-aligned economic activities. Those types of KPIs are also taken as

keywords. They reflect the EU Taxonomy's emphasis on—also financially—measurable alignment with sustainability objectives. Through *coding*, this abstracted to the *code* of “Taxonomy alignment metrics”, as it introduces quantitative indicators that enable companies to demonstrate the extent of their environmental contribution. The emerging *theme*, “Taxonomy alignment”, encapsulates the broader notion of distinguishing economic activities, and their corresponding financial KPIs, based on whether the activity adheres to relevant criteria that govern its Taxonomy alignment. Conceptually, this aligns with the overarching objectives of the EU Taxonomy, which seeks to standardize the classification of sustainable economic activities across sectors, and to incentivize investments into Taxonomy-aligned ones. Within the development of the conceptual model, this statement contributes to establishing a link between financial reporting and contributions to environmental goals.

3.2.2 Green BPM model development

For developing the conceptual model of Green BPM, relevant statements within the Green BPM domain were selected by screening various related work, in line with Naeem et al. [57]. We incorporated existing conceptualizations of BPM presented in [8, 13], in particular the BPM lifecycle, as well as business-relevant works, such as [47, 48, 50]. This was done to bridge the gap between different related business perspectives, and principles of the Green BPM field [9, 10, 38], to include environmental objectives, sustainability practices, and compliance requirements. Figure 4 provides an illustration of the thematic analysis we followed for developing a conceptual model of Green BPM.

As an example, we take the *statement* “Green BPM extends the optimisation of cost, quality, time, and flexibility of business processes with an environmental sustainability dimension. This means that Green BPM concerns the modelling, deployment, optimisation and management of business processes with dedicated consideration paid to their environmental consequences” [9]. This statement illustrated the integration of sustainability into the traditional performance dimensions of BPM. The *keywords* identified were “sustainable business practices”. This is *coded* as “Green Behaviour”, to capture that organizations embed environmental awareness into the management and execution of their business processes, in other words, into organizational behaviour. The resulting *theme*, “Business Process”, reflects the broader focus on aligning business processes with sustainability objectives. At the conceptualization level, this contributes to the understanding of Green BPM as a discipline where “traditional” business goals interlink with sustainability objectives.

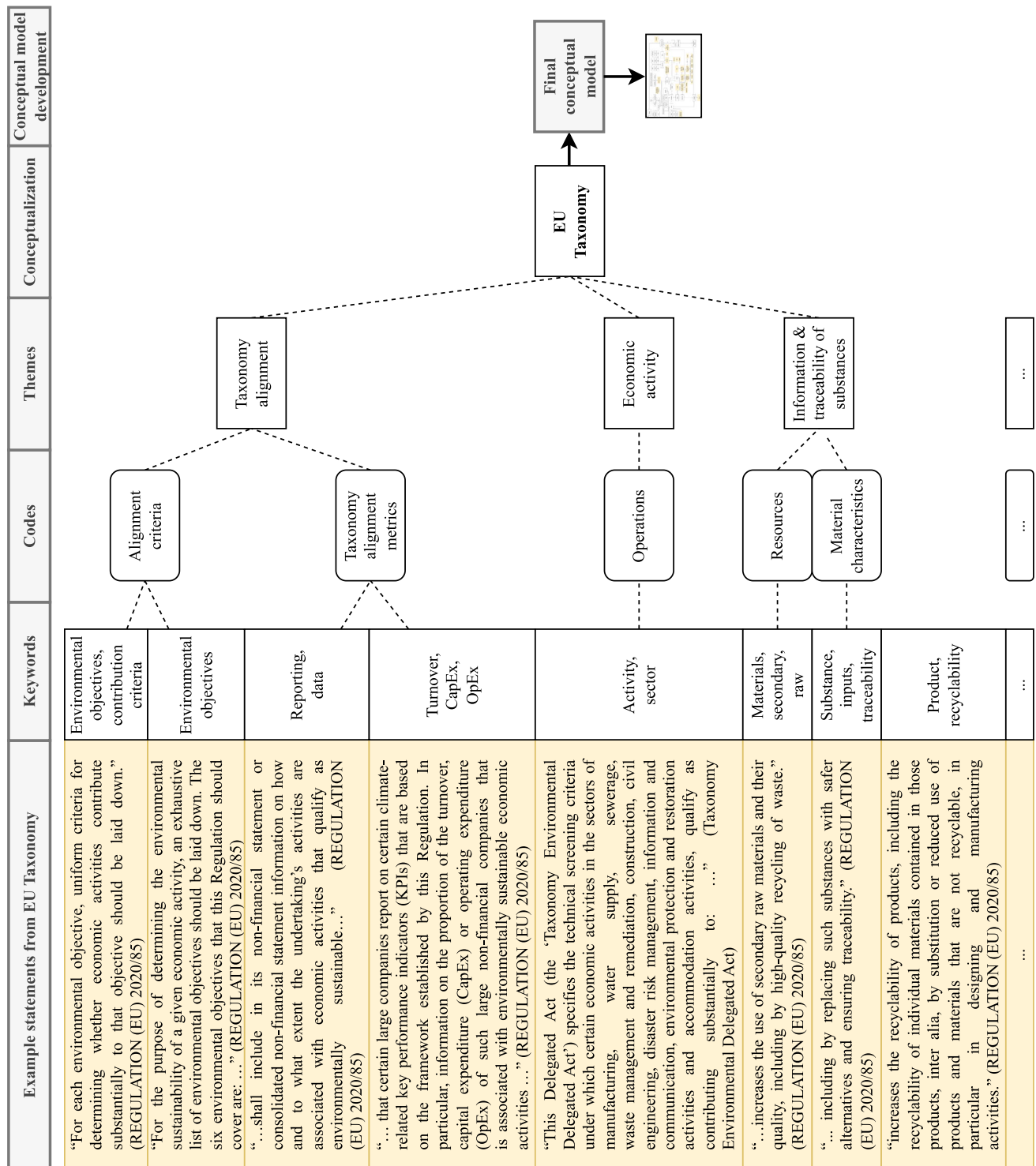
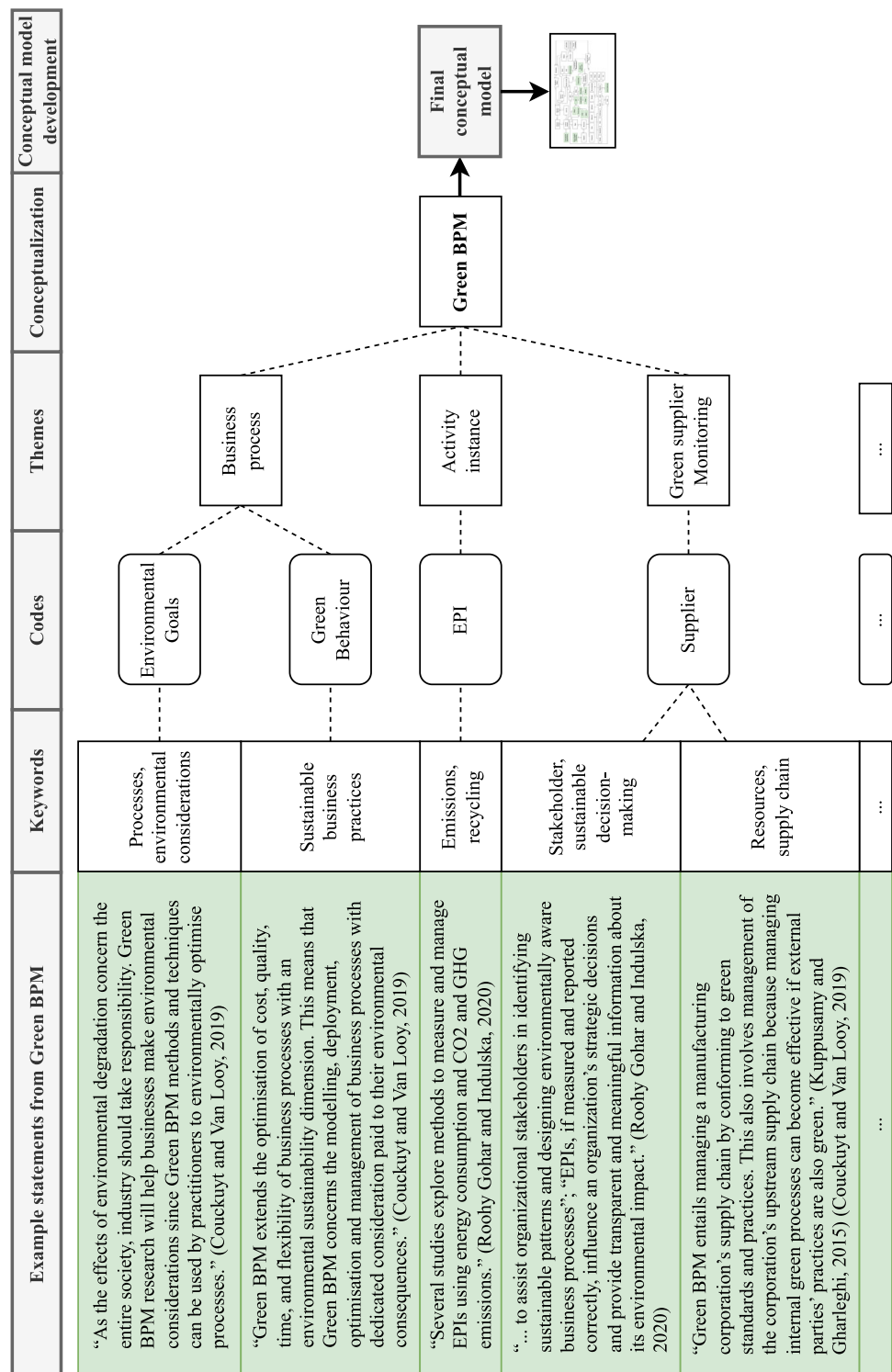


Fig. 3 Illustration of the development of a conceptual model for the EU Taxonomy, adapted from [57]

Fig. 4 Illustration of the development of a conceptual model for Green BPM, adapted from [57]



3.2.3 Aligned conceptual model development

Having established the two conceptual models for the EU Taxonomy and the Green BPM domain, we analysed their similarities and differences to determine areas of alignment. Overlapping concepts were identified by manually comparing entities from both models. Common elements such as economic activities, compliance requirements, and sustainability indicators were assessed. Elements from Green BPM were manually mapped to corresponding concepts from the EU Taxonomy, with economic activities in the EU Taxonomy aligning with processes in Green BPM. Shared concepts, including environmental impact assessments, sustainability reporting, and regulatory compliance were also considered in the alignment.

At the same time, certain elements remained unique to each framework, such as Green BPM's business goal concept and the EU Taxonomy's alignment metrics. These differences were carefully considered to determine whether they should be incorporated or omitted in the final aligned conceptual model. The decision-making was guided by the principle of maintaining relevance to the core objective of our study (i.e. conceptually aligning Green BPM with the EU Taxonomy) and discussed regularly between all authors.

The final step involved manually synthesizing the identified overlaps into a single aligned conceptual model. Redundant elements were removed, to present the model without sacrificing important details. This led to the synthesis of the two developed conceptual models on Green BPM and the EU Taxonomy into a third, separate model that represents their conceptual alignment.

3.3 Support development

Supplementing the development of the aligned conceptual model with a second DSR iteration, we further developed a *decision tree* as a supporting instrument to guide the application of Green BPM approaches in light of the EU Taxonomy in practice. Its purpose is to provide a structured approach for supporting practitioners in determining which type of Green BPM approach from modelling, deployment, optimization, management, or compliance monitoring [9] is potentially applicable for a given problem or task regarding the EU Taxonomy's operationalization. Each question represents a decision node that is supposed to narrow down potential ways of operationalizing the EU Taxonomy with Green BPM and links them to a specific type of Green BPM approach and corresponding capability (see, e.g. [9, 10]). The first and sec-

ond author iteratively and collaboratively designed a decision tree by drawing on existing classifications of Green BPM approaches [9, 10] and our understanding of the alignment between the EU Taxonomy and Green BPM, as represented in the aligned conceptual model. We aimed to devise several guiding questions, such as whether the goal of operationalizing the EU Taxonomy with Green BPM would be ensuring compliance with criteria of the EU Taxonomy that determine Taxonomy alignment, that would help structure the selection of applicable Green BPM approaches. For this, we also relied on the challenges we faced in the first DSR iteration and subsequent publication [19], where we first argued for the applicability of Green BPM approaches in various settings vis-à-vis the EU Taxonomy, albeit without a structured rationale. We continuously refined the guiding questions until both the first and second author were in agreement that the decision tree sufficiently covered all potential application scenarios of Green BPM regarding the EU Taxonomy and offered clarity as to the applicability of Green BPM approaches for them. Afterwards, the third and fourth author verified the first and second author's assessment of the decision tree.

In general, the decision tree is intended to act as a "bridge" between conceptual understanding of the domain (i.e. the alignment of Green BPM and the EU Taxonomy) and operational use (i.e. the operationalization of EU Taxonomy concepts with Green BPM). As Lindland et al. [71] emphasize, conceptual models require adequate pragmatic quality, meaning they must be useful to their intended audience—notably, this usefulness can be supported with additional tools. In this sense, the decision tree is intended to serve as such a tool: it is meant to provide utility to practitioners and researchers, in order to support them in translating the alignment between Green BPM and the EU Taxonomy into the development and application of Green BPM approaches. This way, the decision tree is intended to serve as the "glue" connecting the rather theoretical aligned conceptual model with its application in Green BPM research and practice.

4 Results

In the following, we present the results of applying the conceptual model development methodology on the EU Taxonomy and Green BPM, as well as the supporting approach we developed.⁸

⁸ Due to reasons of scope and coherence, we describe the intermediate models only briefly. Full-size versions of them are made available at <https://doi.org/10.6084/m9.figshare.30316711> [Accessed: 08/07/2026].

4.1 EU taxonomy model

The EU Taxonomy's conceptual model, shown in Fig. 5, outlines the main concepts of the regulatory framework for sustainable economic activities. *Economic Activities or Business Practices* as the core entity of the EU Taxonomy conceptual model are classified according to the NACE code classification [5]. We differentiate between *transitional* and *enabling* economic activities, indicating whether they are moving towards sustainability or facilitating sustainable business practices directly.

Assessing whether an economic activity aligns with the EU Taxonomy is represented via the *Taxonomy Alignment* entity. Relevant for this is whether activities meet *Technical Screening Criteria*, i.e. specific requirements they must satisfy to be considered sustainable. Additionally, activities are linked to *Environmental Objectives*, such as mitigation, adaptation, and biodiversity protection, complying with *DNSH* criteria. *Key Performance Indicators* such as turnover, *operational expenditure* (OpEx), and *capital expenditure* (CapEx) are used to measure the performance and financial implications of sustainability initiatives. These KPIs, along with other reporting values, feed into *Sustainability Reports*, which document the organization's efforts to align with the EU Taxonomy.

To realize a *Product* or *Service*, *Resources* are required and, thus, considered as *Input*. Resources include humans, finances, materials, and data. They contribute to the *Environmental impact* of the organization's *Operations*. *Information and Traceability of Substances* maintain transparency and ensure compliance with sustainability standards, particularly in monitoring the environmental footprint of materials used within processes. Plants, vehicles, and machinery are listed as the organization's assets. They are managed via the *Equipment Restrictions*. *Environmental impact* is caused by *Outputs*, e.g. *Emissions* (such as GHG and others) and *Waste*.

4.2 Green BPM model

The developed Green BPM conceptual model, shown in Fig. 6, presents a conceptual view on Green BPM. A *Business Process* is a collection of related, structured activities that are performed in coordination to produce a service or product serving a particular business goal [8]. A *Process Instance* contains multiple *Activity Instances* representing the real-time execution of individual process activities. These instances are tracked for generating operational data and *Key Performance Indicators* measuring efficiency, effectiveness, and alignment with business goals.

The extended Green BPM model incorporates a broader set of entities to represent the internal and external dynamics of an enterprise. *Resources*, e.g. *Data*, *Material*, *Software*, are the inputs necessary to execute *Activity Instances*.

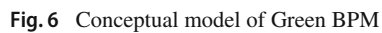
We differentiate between *Raw materials*, *Energy*, *Equipment*, and *Technology* [47, 52]. Furthermore, *Environmental Resources* include resources related to *Air*, *Water*, *Land*, and *Mined resources* [52]. *Enterprise Objects* are functional units or assets within the organization that interact with or are impacted by the *Process Model* [52]. The *Enterprise* entity represents the organization as a whole, incorporating all *Enterprise Objects*, *Business Processes*, and *Compliance Requirements*. *Compliance Requirements* ensure that business operations meet legal, environmental, and quality standards. *Business Goals* drive the design and execution of processes and are categorized into *Hard*, *Soft*, and *Environmental* goals, taken from [50]. *Market* represents the external environment composed of customers, governments, and local communities [52]. *Organization Policy* guides the strategic direction and operational standards within the organization. It includes policies that support environmental sustainability.

In the context of Green BPM, KPIs play a central role in measuring the performance of activities and process instances. However, in an environmentally conscious approach, these KPIs are extended to include *Environmental Performance Indicators* (EPIs) and specifically measure environmental impacts such as emissions, waste, energy consumption, and water usage [38]. The more sustainably *Resources* are used, the better the environmental impact of business processes. *Resources* are linked to the execution of activities and are essential for achieving the desired outcomes of the processes. The concept of *Green Supplier Monitoring* emphasizes the importance of sustainable sourcing by ensuring suppliers meet environmental standards [9].

Green Behaviour captures environmentally conscious actions within the organization, such as recycling, energy conservation, and emission reductions. *Stakeholders*, which include customers, employees, and suppliers, play a significant role in influencing business goals and processes. In this, their *Green Behaviour* is important [9]. *Environmental* goals (i.e. goals stemming from the *environment* of a process) [50] are particularly relevant in the context of *EU Taxonomy*, as they motivate adopting sustainable practices within business operations.

4.3 Aligned conceptual model

The aligned conceptual model that is the result of synthesizing the two previous models into one, shown in its entirety in Fig. 7, integrates concepts from Green BPM and the EU Taxonomy to create a unified (i.e. "aligned") model. The 21 entities highlighted in purple represent aligned concepts that bridge the gap between Green BPM and the EU Taxonomy. The two entities shown in green originate exclusively from the Green BPM conceptual model, while all nine yellow entities are drawn exclusively from the EU Taxonomy. Between all entities, the aligned conceptual model contains 33 rela-



tionships, of which two originate solely from the Green BPM conceptual model, ten from the EU Taxonomy's conceptual model, and 21 from the synthesis of both.

At the core of the aligned conceptual model is the *Economic Activity* | *Business Process* entity, which serves as the bridge between Green BPM and the EU Taxonomy. A business process is subject to *Compliance Requirements*, which are concerned with regulatory, legal, and environmental constraints. The *Activity* entity represents the individual tasks or steps that comprise a business process or economic activity. Each activity contributes to the overall objective of the business process or economic activity and is necessary for realizing a *Product* or *Service*. A specific execution of an *Activity* leads to an *Activity Instance*. *Activity Instances* also interact with *Resources*, drawing from financial, material, human, and other input forms (such as resources that can be “taken” directly from the environment, e.g. sunlight, or air) to execute specific tasks. External partners are represented by *Supplier* | *Supply Chain*. Suppliers provide the *Resources* necessary for processes to operate effectively. In this aligned view, the supply chain is important to achieve business goals and ensure that sustainability criteria are met through the inclusion of Green Supplier Monitoring [38].

In the aligned view, the sustainability of products ties directly to compliance with environmental regulations. The quality, lifecycle, and environmental footprints of products are influenced by the activities and resources used in their production. The impact of these business processes/economic activities on the environment is captured by *Environmental Impact*. An *Environmental Impact* can be divided into a range of subcategories, such as *Recycling*, *Emissions*, *Consumption*, and *Waste*. Although some of them align and are covered by both views, there are more specific types of *Emissions* and *Waste* from the EU Taxonomy view, which is why purple highlighting was not used for them. Subcategories under *Resource* and *Environmental Impact* (e.g. emission types, material inputs) are included to reflect established sustainability standards and enable domain-specific granularity where needed. Another area of overlap is that both *Economic Activities* and *Business Processes* are evaluated using performance indicators. However, while the EU Taxonomy prescribes financial metrics (shown in yellow) for reporting alignment, Green BPM introduces process-level and environmental indicators to support operational sustainability. Finally, the *Compliance Requirement* entity ensures that all economic activities or processes adhere to relevant legal, environmental, and regulatory standards.

4.4 Support for green BPM approaches

While the aligned conceptual model provides clarity regarding the connection of both Green BPM and the EU Taxonomy, the article's overarching purpose lies in enabling the use of

Green BPM approaches for integrating sustainability in light of the EU Taxonomy into their business processes. Since there is a range of approaches offered by Green BPM, there are also various ways in which the EU Taxonomy might be operationalized with them, so that organizations can move towards establishing sustainable (according to the EU Taxonomy) business practices. To organize this operationalization, the decision tree shown in Fig. 8 serves as a *supporting approach* to structure the selection of applicable Green BPM approaches.

Each decision point within the tree represents a question that directs towards a potentially suitable category of Green BPM approaches for a specific way or *objective* of integrating the EU Taxonomy into Green BPM practice for establishing sustainable business practices.

The decision process begins with the question of whether in a particular instance, an organization aims to *prove* and monitor adherence to the EU Taxonomy's sustainability criteria. Corresponding Green BPM approaches involve (regulatory) compliance monitoring (for example, by means of *conformance checking* or other data-driven approaches [7, 72]) as a particular type of deployment approach, which enables the verification of conformity with the sustainability constraints defined in the EU Taxonomy. Regulatory compliance monitoring can verify that business processes meet the DNSH constraints, adhere to the technical screening criteria, and therefore can be considered Taxonomy-aligned [7].

The next question asks whether the organization seeks to implement sustainability within its *strategic or governance structures* as a way towards sustainable business practices. Here, management approaches [9] of Green BPM would be appropriate. Their focus lies on the integration of sustainability criteria of the EU Taxonomy into policies, organizational objectives, change management, and governance [73]. In this step, Green BPM management approaches can integrate sustainability goals and criteria of the EU Taxonomy.

When the goal is to support *real-time tracking or control* of sustainability aspects during process execution as a way of establishing sustainable business practices, deployment approaches [9] of Green BPM enable the measurement of emissions, resource consumption, or environmental performance indicators and allow adjusting process executions based on insights into these indicators.

If the main objective is to *compare or evaluate* different process alternatives in terms of measures of environmental performance as determined by the EU Taxonomy, optimization approaches [9] are relevant. These approaches can be useful when seeking to assess trade-offs between cost, efficiency, and EPIs of business processes, and identifying less impactful alternatives of a given process.

Finally, when the goal is to incorporate sustainability criteria of the EU Taxonomy into *process design*, modelling approaches provide the necessary mechanisms for doing so

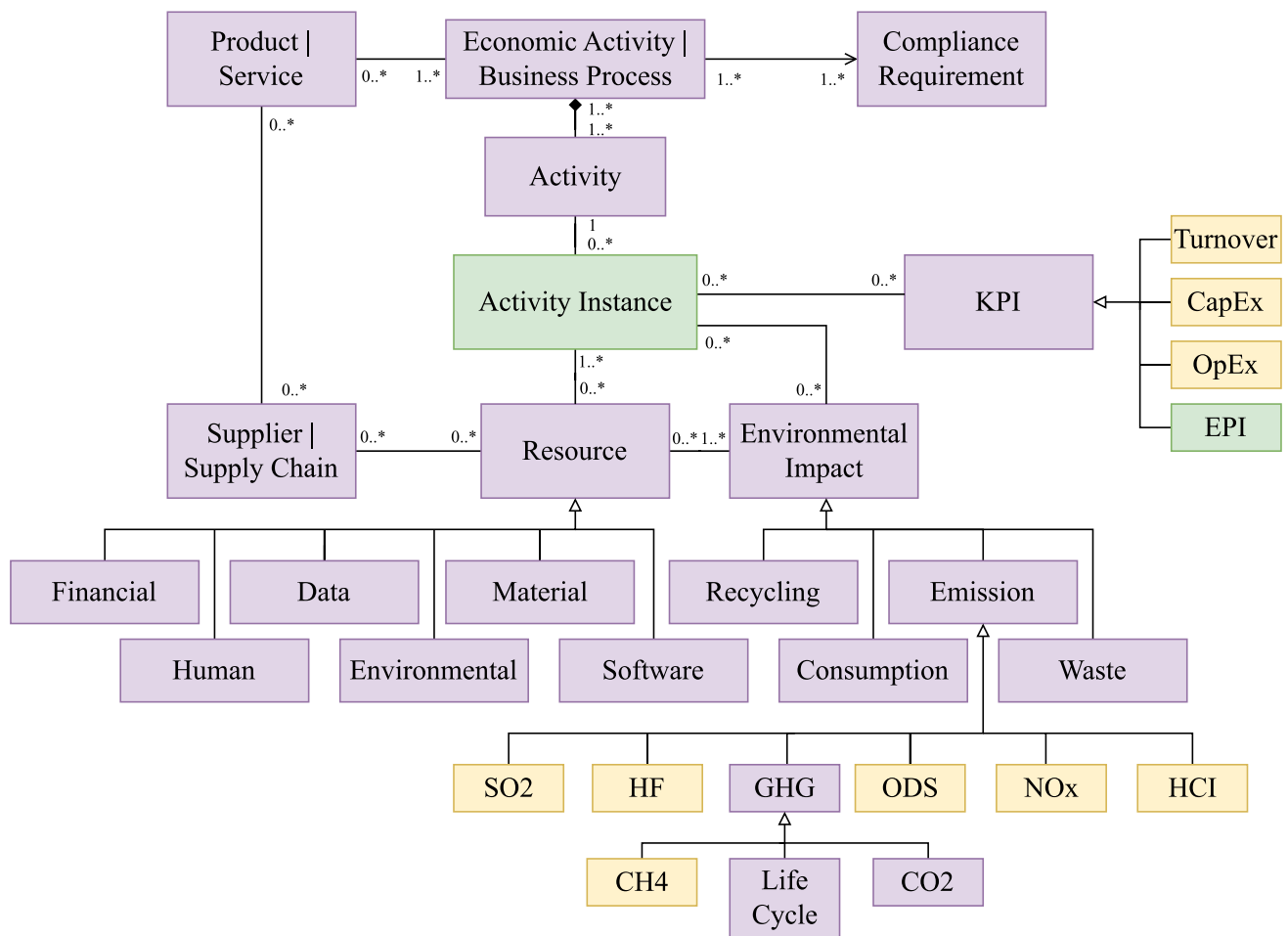


Fig. 7 Conceptual model displaying concepts from Green BPM (in green), the EU Taxonomy (in yellow), and their relationships; aligned concepts shown in purple, see also [19]

[9]. Through the extension of process modelling notations with environmental attributes, or guidelines regarding the environmental impact of process patterns, such approaches allow sustainability considerations to be embedded into business process during design. Ecological aspects such as resource efficiency, recyclability, or waste reduction can be considered upfront and implemented during process enactment, as well as the need of particular activities being executed so that criteria of the EU Taxonomy can be satisfied.

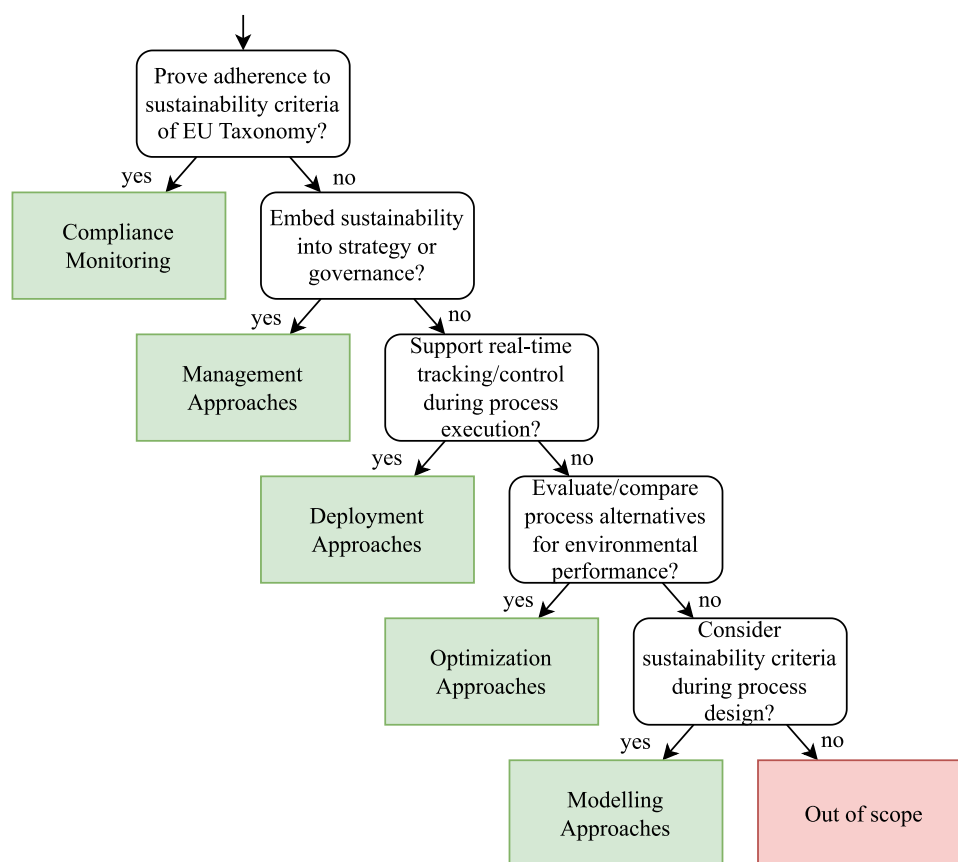
The decision tree could be applied in a variety of settings, so that Green BPM approaches can be used to support organizations in establishing sustainable business practices regarding the EU Taxonomy in multiple ways, with different outcomes. For example, a company that aims to *demonstrate* adherence to the EU Taxonomy's sustainability criteria could, as the supporting approach outlines, apply regulatory compliance monitoring techniques as particular Green BPM approaches for this end. Then, entities to check for could be identified in applicable Taxonomy constraints by using the

aligned conceptual model. A manufacturing enterprise seeking to improve certain EPIs during production, in order to move towards EU Taxonomy alignment, could make use of Green BPM deployment and optimization approaches. Then, the aligned conceptual model could similarly be used to identify entities, and in this case, relevant EPIs, that might be operationalized with the identified approaches. As another possibility, organizations aiming to ensure EU Taxonomy alignment of their business practices 'upfront' could employ modelling approaches offered by Green BPM to consider the EU Taxonomy and its criteria during process (re-)design. Here, the conceptual model could similarly aid in identifying aspects and activities to consider.

5 Demonstration and evaluation

Subsequently, we demonstrate and evaluate the artefacts that we developed for drawing on the EU Taxonomy with Green BPM. Our overarching *evaluation goal* (EG) here is

Fig. 8 Decision tree as supporting approach for determining applicable Green BPM approaches in light of aligned conceptual model



to show that the artefacts provide *utility* [58, 74] in successfully addressing solution objectives *SO1* and *SO2*. This *summative* evaluation [64, 65] corresponds to an *artificial ex-post* evaluation [65]. Our *evaluation strategy* corresponds to what Venable et al. [64] name the “*Purely Technical*” strategy, where artificial evaluation episodes—both formative and summative—are preferred over naturalistic evaluations; the latter involve applying a developed artefact in an empirical real-world setting, such as an actual organization. Our selected evaluation strategy is especially applicable if the actual, practical use of an artefact is not in the *immediate* future [58, 64, 75], which is the case for the conceptual model and supporting approach developed herein.

There are several dimensions to the aligned conceptual model and supporting approach that we aim to assess. In particular, for evaluating the *aligned conceptual model*, we follow the methodology for conceptual modelling according to Lindland et al. [71]. As shown in Fig. 9, we focus on *semantics* to assess the feasible validity and completeness of the model (Sect. 5.1). We also consider *pragmatics* to evaluate utility (Sect. 5.2) of *both* the aligned conceptual model *and* supporting approach. The latter includes both a *single-case mechanism experiment* [61, Ch.18], where we demonstrate *both* artefacts in an artificial scenario, and a *focus group evaluation* [66, 67] to obtain empirical insights into their utility.

Following Tremblay et al.’s [66] guideline for the use of focus groups for artefact evaluation, we present summaries of the evidence obtained for the artefacts’ utility in the focus group sessions and corroborate these summaries with quotes from participants.

The audience of the aligned conceptual model includes Green BPM practitioners wanting to align business practices with the EU Taxonomy, Green BPM researchers wanting to make sense of the EU Taxonomy to research novel techniques and approaches in this field, and EU Taxonomy experts seeking to understand the use of data-driven technique such as those offered by Green BPM in light of the EU Taxonomy. Correct syntax of the model is already given, since we strictly follow the UML standard for modelling.

5.1 Semantic evaluation

For semantic evaluation, we examine the aligned conceptual model’s validity and completeness, considering feasibility [71].

5.1.1 Feasible validity

A *valid* model only contains correct statements regarding its domain. Thus, we systematically assess each *relation* in the

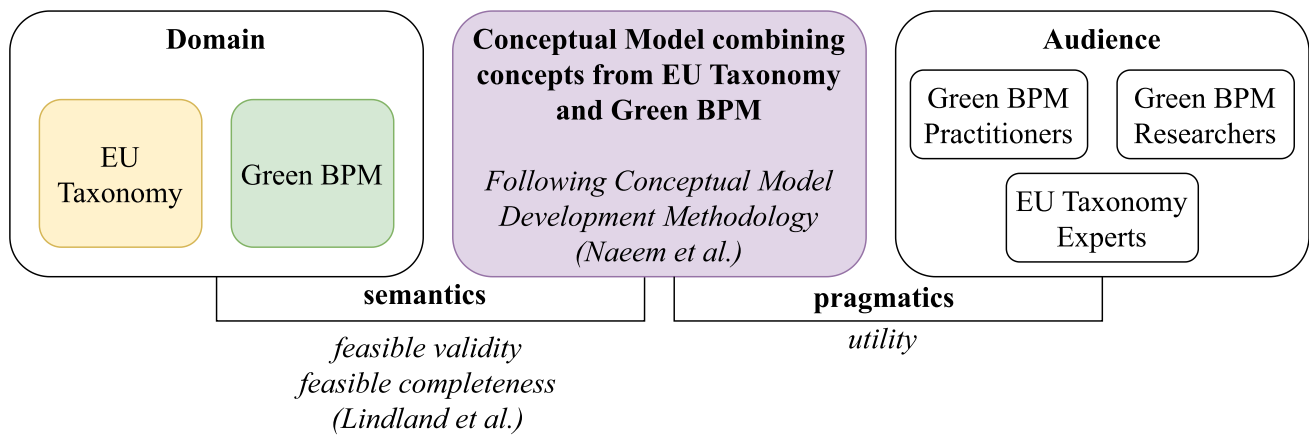


Fig. 9 Methodological overview for the evaluation, adapted from [71]

Table 1 Overview of relations included in the aligned conceptual model and their origins (EU Taxonomy, Green BPM)

Relationship	EUT	G-BPM
KPI—Taxonomy Alignment Metrics	x	
Emissions—Types of Emissions	x	
Product Service—Supply Chain and Environmental Management	x	
Business Process—Activity	x	[8]
Activity Instance—Activity		[8]
Activity Instance—KPI		[8]
Resource—Resource Types		[47, 52]
KPI—EPI		[38]
Resource—Green Supplier Monitoring		[9]
Resources—Activity Instance		[8]
Resources—Environmental Impact	x	[9]
Business Process—Product Service		[8]
Supplier—Resource		[8]
Economic Activity—Compliance Requirement	x	[7]

model and verify whether it accurately reflects the domain (i.e. EU Taxonomy Regulation (EU) 2020/852 [27], or Green BPM) to be considered correct. Table 1 presents all explicitly modelled relations included in the aligned conceptual model shown in Fig. 7 and their origin, proving its validity. For example, the relationship between *Economic Activity* and *Compliance Requirement* is directly validated by the EU Taxonomy's regulatory requirements, while relationships such as those between *Activity Instances*, *Resources*, and *KPIs*

are part of the Green BPM domain. The model is considered valid for both domains.

5.1.2 Feasible completeness

A *complete* model contains all relevant statements defined by the domain. *Feasible* completeness ensures that the model accurately represents the domain while only focussing on *valuable* statements. Thus, we review each statement defined by the domain and assess whether it is already included in the respective conceptual model and whether it adds value to it. If not, it is excluded from the model to reduce complexity. This is done for each conceptual model separately. If the two models of the individual domains (i.e. Green BPM and the EU Taxonomy) are complete regarding their respective domains, the aligned conceptual model representing the intersections of the two models is complete regarding the intersection of their domains.

Statements made by the EU Taxonomy were derived from official sources and related work, including [3, 7, 27, 28, 55]. In line with the methodology of Naeem et al. [57], only relevant concepts have been incorporated into the EU Taxonomy conceptual model, which is why we consider it to be *feasible complete*. Significant but missing statements would have been identified by the methodological process we followed. Thus, we conclude that there are no missing statements that would provide additional value to the conceptual model.

For including concepts of Green BPM, we also followed the predefined and systematic approach by Naeem et al. [57], thereby ensuring that all key components and key statements of Green BPM are included. Section 4 explains each concept included in the model in detail and provides a rationale for why it is relevant to the conceptual model. This shows the significance of the statements made by the Green BPM conceptual model. Therefore, this conceptual model is considered *feasible complete* regarding Green BPM.

Now we further consider the completeness of the aligned conceptual model: The decision to largely include only the overlapping concepts from both conceptual models was made to maintain focus on the main objective, i.e. aligning Green BPM with sustainability goals as outlined by the EU Taxonomy, while ensuring feasible completeness. The majority of concepts that appeared in only one of the two conceptual models was excluded intentionally, as they were not necessary for the primary goal of this alignment. Including additional concepts from only one domain would have introduced complexity without adding value to the model. Notably, some entities, while not mutual between both conceptual models, were still considered in the aligned conceptual model. These include *Activity Instance*, *Types of Emissions*, and *KPIs*. *Activity Instance* was added to represent the execution of a business process or economic activity. The different types of *KPI* represent how both Green BPM and the EU Taxonomy measure business processes or economic activities. While both perspectives use KPIs, it is important to emphasize that the specific KPIs are not the same. *Types of Emissions* and *Waste* were also included. Although the EU Taxonomy covers a broader range of emissions and waste types compared to Green BPM, which focusses on some overarching categories [10], both perspectives deal with these environmental outputs. Thus, including these entities reinforces the model's completeness because it covers both perspectives without introducing unnecessary or invalid elements.

The aligned conceptual model is considered feasible *complete* because all relevant concepts from the EU Taxonomy and the Green BPM conceptual models that are necessary to address both the business process execution and the compliance with sustainability goals have been incorporated. Removing any of the existing elements would compromise the model's ability to address key questions of sustainability and Green BPM alignment, as already demonstrated above, where each concept is justified in detail.

5.2 Pragmatic evaluation

For evaluating the pragmatics of the aligned conceptual model, and the supporting approach's utility, we employ a business process for *battery manufacturing* as an illustrating example. The business process, shown in Fig. 10, consists of four sequential stages, being 1) electrode manufacturing, 2) cell assembly, 3) formation, and 4) pack production, with various subordinate activities, and results in a single battery pack. We iteratively developed the business process model (provided here as a BPMN diagram) based on a description of battery manufacturing of lithium-iron batteries provided by

a large battery manufacturing company⁹ and the description of the economic activity "Manufacture of batteries" (NACE code C27.2). Thereby, we ensure that the illustrating example corresponds to an economic activity covered by the EU Taxonomy. A full-size version is provided in supplementary material available online.¹⁰

For evaluating the aligned conceptual model regarding its utility (i.e. does it help the model's audience to identify the conceptual alignment between Green BPM and the EU Taxonomy [74]), we *first* apply the model and supporting approach to the battery manufacturing as an example (Sect. 5.2.1). For this, we identify and summarize constraints formulated in the EU Taxonomy [25] for the battery manufacturing process (i.e. the technical screening criteria) and identify entities of the aligned conceptual model that relate to these constraints. Based on the constraints and their corresponding conceptual model entities, we identify potential types of Green BPM approaches with which the constraints formulated for the conceptual model entities can be assessed, improved, or made use of. *Second*, we conduct a round of focus group sessions with Green BPM researchers and EU Taxonomy experts, to investigate whether the aligned conceptual model and supporting approach provides utility to them (Sect. 5.2.2).

5.2.1 Demonstration

When applying the aligned conceptual model to the battery manufacturing example,¹¹ we find, as shown in the first two columns of Table 2, that all concepts of the aligned conceptual model are covered by our illustrating business process. We stress that Table 2 is not intended as an exhaustive, constraint-by-constraint analysis of the process model in Fig. 10, nor as a redesign of it towards EU Taxonomy alignment. It rather demonstrates how a set of EU Taxonomy constraints for battery manufacturing can be traced to concepts of the aligned conceptual model and, via the supporting approach, to the categories of Green BPM approaches relevant for operationalizing them. We illustrate the conceptual model's and supporting approach's utility independently of any specific process (re-)design. The aligned conceptual model serves as a translation layer between EU Taxonomy constraints and Green BPM approaches. For example, the *Economic Activity*

⁹ See <https://inside.lgensol.com/en/2023/06/infographics-3-battery-making-at-a-glance/> [Accessed: 08/07/2026].

¹⁰ <https://doi.org/10.6084/m9.figshare.30316711> [Accessed: 08/07/2026].

¹¹ Note that we use a representative set of EU Taxonomy constraints for the battery manufacturing process as input here, rather than the BPMN diagram shown in Fig. 10. This is because the EU Taxonomy's constraints apply to an economic activity (e.g. battery manufacturing), not to individual steps or relations within a process model, so the BPMN diagram does not provide a suitable level of granularity for this mapping.

Table 2 Summarized constraints from the EU Taxonomy for the example process, with relating concepts from the aligned conceptual model (ACM) and potential Green BPM approaches

EU Taxonomy Constraints	ACM Concepts	G-BPM Approaches
Battery Manufacturing	Economic Activity	Modelling
Report turnover, CapEx, and OpEx to show alignment with sustainable activities	KPIs	Compliance Monitoring
Rechargeable batteries, battery packs, accumulators	Product	Modelling, Management
Recycle end-of-life batteries	Activity	Modelling, Compliance Monitoring
Design products for high durability, recyclability, easy disassembly, and adaptability	Product	Modelling, Management
Materials must be sourced responsibly, incorporating secondary raw materials	Material, Supplier	Management, Compliance Monitoring
Substantial GHG emission reductions in transport	Environmental Impact - Emission - GHG	Deployment, Optimization
Recycle at least 70% of non-hazardous materials	Environmental Impact - Recycling	Optimization
Support GHG reduction, comply with EU waste laws, implement sorting systems	Environmental Impact - Waste	Deployment, Optimization
Information on and traceability of substances of concern throughout the lifecycle of manufactured products	Environmental Impact - Consumption	Deployment, Management
Minimize use of hazardous substances	Resource - Material	Modelling, Deployment
Environmental impact assessment has been conducted, and the necessary measures have been implemented	Resource - Environmental	Compliance Monitoring
Adherence to EU labour laws and standards	Resource - Human	Management, Compliance Monitoring
Software systems aid in resource efficiency, emissions management, and compliance	Resource - Software	Deployment, Optimization
Report on sustainability metrics as part of disclosure obligations	Compliance Requirement	Compliance Monitoring

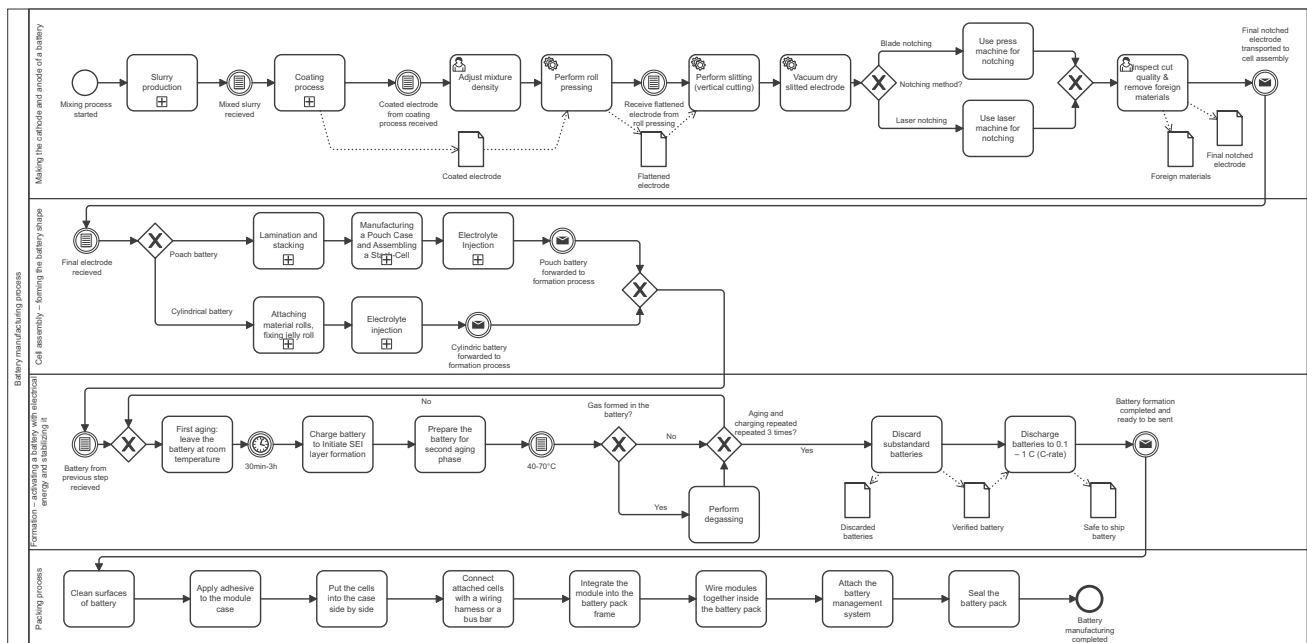


Fig. 10 A BPMN diagram of a battery manufacturing business process [19], covered by the EU Taxonomy. A full-size version is available as supplementary material online

concept maps the entire business process of battery manufacturing. An obligation to report financial KPIs relates to the *KPI* concept. The requirement for the business process to produce rechargeable batteries is covered by the *Product* concept, as is the requirement for the product to be durable, recyclable, “disassemblable”, and adaptable. The requirement to recycle at least 70% of non-hazardous materials maps to the *Environmental Impact - Recycling* concept, whereas the requirement to use software systems to aid in resource efficiency, emission management, and compliance aligns to the *Resource - Software* concept. Finally, the requirement to recycle end-of-life batteries maps to the *Activity* concept, as this requires that the process contains an activity in which the recycling is done (for which then also an *Activity Instance* must exist).

In view of the mapping of EU Taxonomy constraints to the aligned conceptual model, we can better reason about potential applications of Green BPM approaches to assess or improve Taxonomy alignment of our illustrative process. Here, we provide high-level examples of how a selection of applicable Green BPM approaches and subsequent operationalization of aligned concepts could work based on the supporting approach developed above and shown in Fig. 8. This selection of potentially applicable Green BPM approaches, depending on the setting in which the approaches are subsequently intended to be applied, is described below; potentially applicable approaches are also provided in the third column of Table 2.

For example, we could use modelling approaches to make sure that recycling end-of-life batteries is part of the business process, since so far, no such activity is part of Fig. 10 and, as shown in the supporting approach of Fig. 8, modelling approaches allow us to consider this criterion during process design. Subsequently, we could use compliance monitoring approaches to ensure that recycling actually takes place, in order to prove adherence to this criterion — see again the supporting approach of Fig. 8. We can implement deployment and optimization approaches for addressing various constraints that require GHG emission reductions, since, as shown in Fig. 8, they enable the tracking and reduction of, e.g. environmental impacts and emissions. With management approaches, we can make sure that information on the traceability of specific substances is collected, and use deployment approaches for collecting adequate data. While the implementation of all approaches requires further understanding of the constraints at hand, we can now nonetheless better understand how they relate to entities known from a Green BPM point-of-view and reason about the kinds of Green BPM approaches that might be relevant—also light of the supporting approach shown Fig. 8, which clarifies which Green BPM approaches fit to different ways of operationalizing aligned concepts of the EU Taxonomy.

5.2.2 Focus group evaluation

To further substantiate the utility provided by the aligned conceptual model and its supporting approach, we conducted two focus group sessions with Green BPM researchers and EU Taxonomy experts following [66, 67] in November 2025, each approximately 60 min in length. Five participants were recruited from our extended professional network, using *purposive sampling* [76], based on their respective expertise. The first focus group session (FGS1) consisted of two researchers with prior expertise in Green BPM research; the second session (FGS2) of two researchers with prior expertise in the EU Taxonomy and one industry practitioner with expertise in EU Taxonomy reporting. This distribution of expertise allowed us to receive input from various parts of the aligned conceptual model’s audience regarding its utility.

In each focus group session, which both were conducted online via *Zoom* by the main author, we first provided background information on Green BPM and the EU Taxonomy. Afterwards, we presented the aligned conceptual model and asked participants to identify concepts from the conceptual model in a subset of the evaluation’s summarized constraint (see Table 2). Afterwards, we asked them to identify suitable Green BPM approaches for operationalizing these constraints with help of the supporting approach. We wrapped up the session with a discussion of whether the aligned conceptual model and the supporting approach were perceived as helpful for understanding the alignment of Green BPM and the EU Taxonomy, and the potential of operationalizing concepts of the EU Taxonomy’s constraints with Green BPM approaches. Finally, the participants were invited to discuss open questions and concerns.

Overall, both focus group sessions provided evidence for the conceptual model’s and supporting approach’s utility, as is summarized in Table 3. In the following, we corroborate these findings with additional quotes from focus group session participants, in line with [66]. Across both focus group sessions, all five participants were able to reason about which entities of the aligned conceptual model were embedded in the constraints they were presented. They noted that “*it helped me a lot, in fact, it helped me a great deal. I was able to immediately classify where I could apply [concepts of the aligned conceptual model]. It was very helpful for me because I knew right away how I could classify a [concept] in terms of level in a business process*” (Green BPM Researcher 1), and “*from the model, I can learn: what is the connection, [...] what are the concepts that can be mapped from both worlds?*” (Green BPM Researcher 2). They also agreed that “*It makes sense intuitively,*” (Industry Practitioner) and “*I see this overlap [between Green BPM and the EU Taxonomy], it makes sense*” (EU Taxonomy Researcher 1). In total, all five of the five participants agreed to the aligned conceptual model’s utility.

Table 3 Summary of focus group evaluation results, following [66]

Focus Group Session	Evidence of Utility: <i>Conceptual Model</i>	Evidence of Utility: <i>Supporting Approach</i>
FGS1	Yes	Yes
FGS2	Yes	Yes

Further, five of the five focus group sessions' experts were able to apply the supporting approach to reason about potentially applicable Green BPM approaches that would operationalize the respective aligned concepts, and all five participants agreed to its utility. Here, they noted that "*I found this supporting approach helpful*" (Green BPM Researcher 2) and that "*the supporting approach helped me just as much as the [aligned conceptual model]*" (Green BPM Researcher 1). Further, "*I found it really exciting, and it was definitely a piece of the puzzle that I was missing, how process management actually looks like [in relation to the EU Taxonomy]. Because, as I had always suspected from my contact with companies, they already have so much data that it doesn't actually take much effort to implement sustainability [at the process level]. So I thought it was good to see that, from my point of view, it really fits together well. [The conceptual model and supporting approach] really helped me in that regard*" (EU Taxonomy Researcher 2).

6 Discussion and conclusion

In this work, we have designed and evaluated a conceptual model which conceptualizes the alignment between concepts of the EU Taxonomy and Green BPM, and a supporting approach which structures the use of Green BPM approaches for the EU Taxonomy in various settings. Demonstrating and evaluating the artefacts in a substantive, artificial ex-post evaluation via an exemplary case and two focus group sessions made up of five participants comprising Green BPM researchers, researchers with expertise on the EU Taxonomy, and industry experts, has shown that, in line with our EG, they provide utility in addressing *SO1*, and *SO2*. Jointly, the artefacts conceptualize the alignment of Green BPM and the EU Taxonomy (answering *RQ1*) and guide the use of Green BPM approaches for the EU Taxonomy (answering *RQ2*).

By making the involved concepts and relations explicit, we have contributed towards (1) empowering practitioners to apply Green BPM approaches for assessing and improving Taxonomy alignment of business practices, (2) enabling research to develop novel Green BPM approaches in light of the EU Taxonomy, and (3) allowing Green BPM tool providers to align their systems with the EU Taxonomy. The

supporting approach we propose helps to guide the operationalization of concepts aligned between Green BPM and the EU Taxonomy with Green BPM approaches, for proving or improving Taxonomy alignment—that is, sustainable business practices w.r.t. the EU Taxonomy. Besides the use of Green BPM approaches for considering EU Taxonomy alignment, we have also extended our understanding of how Green BPM can contribute to a *regulatory* view on environmental sustainability, by outlining how Green BPM can make use of the EU Taxonomy's criteria for *identifying* and *moving towards* sustainable business practices in their light.

Still, it should be acknowledged that the role the EU Taxonomy can play in achieving environmental sustainability is contested. This is in part due to its notion of sustainable development, which has been criticized as representing "weak sustainability" [77] and as being unsuited to achieve a state of *actual* sustainability [78, 79]. Consequently, while the aligned conceptual model proposed herein explicates the alignment between the EU Taxonomy and Green BPM, and the supporting approach outlines how Green BPM approaches can be used in light of the EU Taxonomy, doing so can only bring about "weak" sustainability. If the intended outcome of applying Green BPM is to contribute towards an *actual*—or *strong*—notion of sustainability (cf. [37, 77]), the approach we propose would arguably be unsuited. Nonetheless, in the light of *regulatory* demands that seek to increase adherence to the EU Taxonomy, this article still presents a contribution to Green BPM research *and* practice.

Threats to Validity. There are several limitations to the validity of our study that we need to acknowledge. *Firstly*, the way the intermediate and final models were developed and statements were selected was subjective in nature. However, we aimed to counter potential biases by continuously discussing among the author team each decision during model development and evaluation and resolving any arising conflict. Further, we have aimed to provide further evidence to substantiate our model development, both via illustrations (see Figs. 3 and 4) and supplementary material. *Secondly*, our focus group sessions that served to illustrate the conceptual model's and supporting approach's utility were limited in size, which in turn limits the generalizability of our claim to utility. Similarly, the lightweight quantitative evidence regarding the agreement of focus group session participants as to the artefacts' utility, despite being supporting evidence, only offers limited generalizability beyond the specific focus group sessions and their participants. However, conducting two focus group sessions in our setting is consistent with recommendations on using focus groups to evaluate artefacts for their utility [66, 68]. Further, focus groups *also* do not intend to achieve generalizability, but rather, to minimize sample bias [67]. For this, we recruited experts from different institutions with various backgrounds who possess expertise in one of the three intended audiences of the aligned

conceptual model. Splitting—or segmenting [67]—the focus group into two sessions thereby allowed us to *triangulate* the findings of the evaluation. *Thirdly*, the EU Taxonomy as a *political* project may be subject to change in its implementation (cf. e.g. [80]). However, we have shown that this *type* of regulation, making requirements for economic activities and outlining criteria for when they contribute to certain environmental objectives, can be integrated into and used for Green BPM. And finally, the evaluation was limited to semantics and pragmatics, and a *real-world case study* for usability regarding, e.g. Green BPM practitioners is, so far, missing. Nonetheless, we have shown the feasibility and utility of the developed conceptual model and supporting approach with a *real-world-adjacent* scenario and an empirical evaluation by means of two focus group sessions.

Future Work. Potential future research building on the study reported herein may include further empirical evidence for the utility of our conceptual perspective on alignments between the EU Taxonomy and Green BPM concepts—concrete applications of approaches after having identified them via the conceptual model and supporting approach could strengthen the validity of our findings further; demonstrating the operationalization of EU Taxonomy constraints with Green BPM approaches likewise would be valuable. Similarly, a case study with practitioners in industry could help in evaluating the applicability and usability of the aligned conceptual model and supporting approach, which we, so far, did not explicitly cover in our evaluation. Here, an additional round of focus group sessions targeting the artefacts' usability, e.g. by drawing on the System Usability Scale [81] could also be helpful. Further, as diagnosed in previous work [82, 83], we see substantial potential for technical (in particular, automated or semi-automated) support for checking conformance of specific business processes regarding regulations; we believe that the conceptual model developed herein can form the basis of such an approach regarding the EU Taxonomy.

Supplementary information We provide supplementary material, including high-resolution figures and further details of the conceptual model development, in a FigShare repository available at <https://doi.org/10.6084/m9.figshare.30316711>.

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Declaration

Conflict of interest The authors have no conflict of interest relevant to this article to report.

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