Development of a reference system for the modeling and assessment of social, economic and ecological sustainability

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Abstract

Society is gradually recognizing that the world is in a sustainability crisis. This is manifested by protest movements such as Fridays for Future, but also by changes in purchasing behavior in saturated customer markets. There, the predicate sustainability often decides on the purchase of a product or service [16]. However, it is currently not possible to clearly define what constitutes a sustainable product or service, as there is a lack of transparency regarding the resources used and their utilization within the production process. But this transparency is essential in order to be able to analyze, compare and evaluate processes and their output. Current business process models, which are often used to create transparency, focus strongly on economic aspects, but to a limited extent only on ecological aspects. Social aspects are considered hardly and if they are then only rarely together with the other two categories. With the PhD project, the author wants to contribute to making sustainability in processes of all its facets modelable, assessable and comparable. In order to achieve this, definitions of a desired sustainable world, such as the Sustainable Development Goals of the UN [24], as well as the German Supply Chain Sourcing Obligations Act or the European Supply Chain Act, which is currently being developed, will be used to formulate clear requirements for holistic sustainability models. The aim is to create a uniform modeling basis, which will be supplemented by a key sustainability indicator, that aggregates the measured impacts across several sustainability dimensions in order to make processes comparable with each other in terms of their structure but also in terms of their output.

Keywords

Sustainability, Sustainable BPM, Green BPM, Business Process Modelling, Business Process Notations, SDG, Sustainable Development Goals

1. Motivation, Context and Related Work

Business processes are omnipresent in our lives. They can be described as a sequence of value creation activities that are triggered by one or more process inputs and which pursue the goal of creating added value for the subsequent process or the customer [22].

For example, weekly grocery shopping in a supermarket can be seen as an order-to-cash process of the supermarket. Here, the European consumer buys bananas, for instance, which have been produced in distant countries and then transported to the destination country. This means that in addition to the purchasing process, there is an additional supporting production and logistics process. This process can be described in the form of an informal, semi-formal or formal notation and thus reflect the operational processes in business process models.

This descriptive representation is used, among other things, for documentation with subsequent analysis and potential reorganization of business processes [14]. By creating transparency of a process,

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the modeling of business processes, thus, creates the basis for a possible discussion about the current and a future state of a business process. By generating a general understanding, it forms the basis for changing corporate structures and initiating process improvements [18, 21]. This approach to processes is described as business process management. However, it should not be understood as a pure modeling tool. Rather, it is a technique which, in addition to the modeling language, provides methods and concepts to introduce, execute and monitor processes [20]. Since monitoring is a very important task in this context, key performance indicators (KPIs) are an elementary component of BPM.

A retrospective view of BPM over the last few years shows that the initial focus of the approach was strongly on optimizing the factors of cost, quality, flexibility and time savings [13, 19]. When comparing existing BPM tools, it is additionally apparent that there has been a clear focus on economic efficiency gains so far [15]. However, as in recent years sustainability issues such as rapid environmental degradation, exploitation of limited resources, inequality within societies, or access to health systems and clean drinking water are more and more in the focus of societal attention, they are also entering the scientific discourse and BPM [5, 11, 25, 26]. The effects of the general attention can be seen, among other things, in saturated customer markets, in which the sustainability factor can be decisive for the sale of services and products [16].

The concept of sustainability is generally described as complex. Scientifically, the term has been defined in the corporate context by Elkington's [3] triple bottom line approach, which describes a sustainable company as one that takes into account or promotes economic prosperity, ecological quality and social justice. The challenge here is to consider and reconcile multiple, interdependent dimensions on the one hand, and to assess the impact of processes and their activities on social and environmental sustainability on the other [7, 27]. Specifically, when optimizing processes toward sustainability, it is important to note that only when two of the three dimensions described by Elkington improve and the third does not deteriorate, development in the right direction is given [4].

Governmental initiatives try to define sustainability, for example, by the 17 Sustainable Development Goals (SDGs) of the United Nations [24] in its 2030 Agenda, in which the focus is placed for example, on combating hunger in the world or the sustainable production of goods and their consumption. The SDGs are based on 17 goals, which are made up of a total of 169 targets. They are not formally a law, but through their ratification by 193 states they form the basis for political and corporate decisions. For its part, the German government has created a basis in the German Supply Chain Sourcing Obligations Act, which obliges many companies operating in Germany to monitor their supply chain for child labor, general discrimination or the promotion or combating of corruption, among other things, and to take appropriate measures. It also provides for companies to be held liable for violations. In order to be able to carry out this monitoring of the supply chains, it is necessary on the one hand to create transparency about them and on the other hand about all sustainability factors within them. BPM can contribute to this and lay the foundation for the design of new, sustainable process models based on existing models [15]. For this purpose, the common notations and tools must be adapted or extended [6].

This requires clear standards in modeling, which enable sustainability to be documented in models [8, 17]. These can theoretically be built in any common modeling language, as long as they take into account, for example, the requirements of Melville [11] for the representability of complexity and multi-layeredness and the avoidance of load shifts [10].

To take this into account, current research activities in the context of sustainable BPM deal, amongst other things, with the applied evaluation of modeling tools and the design or further development of concepts, patterns, and guidelines with high focus on ecological sustainability [9, 13]. Yet, it also calls for the application of existing modeling languages in modeling tools under the creation of holistic framework concepts. These approaches and models are mostly evaluated or compared with the measure of the reduction of used energies or the emission of CO2 equivalents [12]. Thus, an assessment of social criteria currently occurs only to a very limited extent in modeling. Therefore, previous approaches have to be critically considered with respect to the claim of a holistic approach [23]. Especially in the field of modeling and assessment of social sustainability, weaknesses are currently recognized [23]. This can neither be described by conventional modeling approaches, which evaluate the involvement of roles and resources in processes [22], nor by the previous context of social BPM, which focuses on the interaction of people in processes [2].

2. Research Questions and Research Approach

To close this gap, the aim of this PhD project is to provide a basis on which processes can be modeled, evaluated and compared with respect to economic, ecological and social sustainability. For this purpose, existing modeling languages are to be critically reviewed and, if necessary, extended in such a way that they can represent the sustainability aspects in a target-oriented way. In addition, a maturity model will be developed with the aim of making processes comparable and assessable in terms of their sustainability. Moreover, it is to be made usable as an extension of existing IT software, so that companies are enabled to evaluate their processes.

In order to achieve this, the following main research questions can be derived:

F1. How can existing economic, social and environmental factors be used or extended in modeling languages to develop a sustainable-aware language that meet the requirements of policies driven by political initiatives such as the UN SDGs or the German Supply Chain Sourcing Obligations Act?

F2. How should the boundaries of a BPM model be set in which economic, environmental and social sustainability are mapped so that the model itself is not overloaded?

F3. How must a criterion be designed to reflect the maturity of a process in terms of economic, ecological and social sustainability in equal measure?

F4. How can a comparison between company processes be made on the basis of this extended or adapted modeling?

3. Research Agenda

To answer F1, existing modeling approaches on the one hand and criteria of sustainability developed by political initiatives on the other hand will be analyzed and evaluated. Thereby, requirements from legislation will be compared to existing notation approaches, gaps in both will be identified and these will be classified. For this purpose, the principles of proper modeling according to Becker are used [1]. These gaps serve as requirements for the development of further business process models that holistically represent sustainability, which will be elaborated in the following. The model extensions are to be continuously checked for their applicability in order to prevent the creation of excessive and unmanageable complexity. For this purpose, it is conceivable to use or extend on high-level XML-nets based BPM tools like the Horus modeling tool [22], which is currently strongly oriented toward the implementation of enterprise software or digitization concepts. In this way, the application reference should also be critically verified. With regard to F3, the aim is to expand the existing performance measurement systems, which, as already described in previous sections, deal with costs, quality, flexibility and time savings or energy or CO2 equivalent savings. Through the further development, topics of social sustainability are to be mapped as well. The aim is to relate these indicators to one another and to combine them in a single overarching sustainability indicator. With the help of the expanded models and the matrix of indicators, a concept will be created to answer F4 and thus enable a comparison of corporate processes or companies with each other.

4. Current Research Stage

My research activity regarding the development of a reference model for the modeling and evaluation of social, economic and ecological sustainability is currently at the beginning. First analyses to create a target-oriented and complete requirements matrix are in progress.

So far, they have been implemented for the German Supply Chain Sourcing Obligations Act and the UN Sustainable Development Goals. Furthermore, selective implementation tests of the elaborated

sustainability requirements from the German Supply Chain Sourcing Obligations Act supplemented by requirements from the targets of the Sustainable Development Goals of the UN [23] in a modeling tool based on extended Petri nets revealed gaps in the applicability of individual requirements. Problems were encountered when trying to find suitable model types for visualizing and evaluating requirements such as anti-discrimination and the creation of fair working conditions. Uniform working conditions according to the German Supply Chain Sourcing Obligations Act or SDD 8.5 ("By 2030, achieve full and productive employment and decent work for all women and men, including for young people and persons with disabilities, and equal pay for work of equal value" [24]) could not be assigned to a model type, since they represent conditions that are not visible in the execution of a process, but directly influence it. Similarly, the fight against discrimination (e.g. SDG 10.3, "Ensure equal opportunity and reduce inequalities of outcome, including by eliminating discriminatory laws, policies and practices and promoting appropriate legislation, policies and action in this regard" [23]), which can be the result of a support process or compensation process, but currently cannot be represented in a target-oriented manner in a main process. Hereby the concrete need for extensions in existing notations was shown.

Building up on these findings, the next step is to analyze the current state of discussion of the European Supply Chain Act and others to consolidate the requirements for a sustainability model.

In addition, considerations are currently being made to extend existing business process models to include further targeted artefacts.

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