Towards a Framework for Business Process Sustainability Analysis

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Abstract. The assessment and improvement of business processes is an important driver of success in organizations. However, as opposed to established KPIs and other metrics, the sustainability of business processes is much less straightforward to measure and quantify, partly due to the term's ambiguity and an inherent difficulty to be measured. In order to facilitate sustainability-oriented process redesign beyond greenhouse gasses, existing methods can be enriched by considering additional information from methods such as Life Cycle Assessment. This enables a holistic and flexible analysis, and can serve as a measurable driver for process redesign.

Keywords: Sustainability · Business Process Management · KPI.

1 Introduction

It is undeniable that climate change, driven by human influence, has a severe impact on the world surrounding us. In order to avert even further alterations with potentially catastrophic and unforeseeable consequences, actions have to be taken. In its most recent report, the International Panel on Climate Change states that limiting the emission of CO_2 and other greenhouse gasses to at least net-zero would be required to curb the extent of climate change [8]. Furthermore, toxic substances introduced into the environment as a result of, for example, wasteful manufacturing, play a significant role in the endangerment of biodiversity and the promotion of risks to human health [12].

Industry and academia have reached a consensus that both a reduction of emission of greenhouse gasses and an overall promotion of sustainability hold the potential of mitigating or dampening the consequences of climate change. Business Process Management (cf. [16]), dealing with analysis, design, and implementation of business processes, has led to various approaches for analysing and improving the sustainability of these business processes, but these approaches generally limit themselves to a few aspects which they assess (e.g., greenhouse gas emissions or energy consumption), and a holistic approach has not yet been established. In the following, related work and the concept of sustainability will briefly be discussed, and a method that aims at alleviating some existing drawbacks by combining additional perspectives with business process simulation will be outlined.

J. Manner, D. Lübke, S. Haarmann, S. Kolb, N. Herzberg, O. Kopp (Eds.): 14th ZEUS Workshop, ZEUS 2022, Bamberg, held virtually due to Covid-19 pandemic, Germany, 24–25 February 2022, published at http://ceur-ws.org
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CEUR-WS.org/Vol-3113/paper2.pdf

2 Related Work

In the recent years, three main ways of integrating aspects of sustainability into the toolset of BPM have emerged:

1. **Activity-based costing, ABC** — Methods which aim at measuring the impact of a business process based on the individual cost of activities in terms of, most commonly, greenhouse gasses, derived from a priori knowledge of what cost an activity incurs. Activity-based emission analysis (ABE) (cf. [10, 11]) focusses on emissions according to the different scopes of the GHG Protocol[1], a set of standards for greenhouse gas accounting for businesses and governments.
2. **Structure-based costing** — Methods which aim at measuring a process-level degree of sustainability by checking whether specific patterns that contribute to sustainability in the domain of that process are followed [6, 7].
3. **Modelling concepts** — Methods which aim at enabling the expression and modelling of the carbon footprint and greenhouse gas emissions of a process [11].

Generally, all these approaches operate under a shared definition of sustainability: $Sustainability = environmental + social + economic\ sustainability$ (cf. [15, 18]). As per [1], the economic facet deals with controlled growth, the social facet with inter- and intra-generational justice, and the environmental facet with preservation of the natural basis of life and its lifecycle. Figure 1 illustrates the interrelationship between the three facets.

The focus here, however, generally lies on environmental sustainability, and in that, only on greenhouse gasses according to the GHG Protocol [6, 10, 17] or energy consumption [13]. Nonetheless, it should be noted that the aspect of environmental sustainability is concerned with the preservation of the natural basis of life and its lifecycles, and the security of the ecological conditions of human survival in general (cf. [1, 5]). Here, it should be stressed that not just greenhouse gas emissions have a negative impact in that regard (cf. [12]), and therefore more factors should be considered in such an environmental sustainability analysis – be it the amount of toxic materials involved, or amount of waste generated, or the general detrimental impact the involved materials have on the environment. Furthermore, all three ways strongly constrain themselves to a specific domain, or even a specific process, in order to validly assess the sustainability. Additionally, activity-based costing is predominantly based on

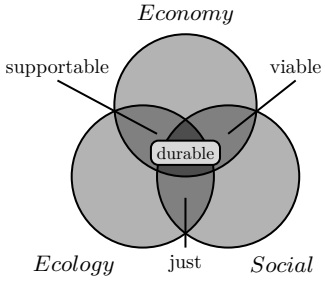

Fig. 1. Triad model of sustainability, adapted from [9]

[1] https://ghgprotocol.org/

pre-determined costing measures, which assign costs to activities derived from certain measures, e.g., the amount of CO_2 produced per page of paper, and the average number of sheets of paper involved in that activity. However, more than just paper might be involved in that activity in a greenhouse gas-causing fashion, and the degree of sustainability might be influenced more heavily by outliers, not allowing the aggregation using the average. Moreover, to what degree certain patterns contribute to the sustainability of a process highly depends on estimates as well, where the influence some factors have over others is never assessed but just estimated in order determine the more preferable patterns (cf. [4, 6]).

3 Research Objective

The overall situation leads me to pose the following research questions:

1. How can the current understanding of sustainability be adapted to provide a holistic picture in conjunction with a processes-level view?
2. How can ABC/ABE methods be extended to include other factors beyond greenhouse gas emissions according to a holistic understanding of sustainability?
3. How can this extension be leveraged in a practical setting, e.g., in order to drive process redesign, and how can this be implemented?

In order to establish a holistic approach that enables a quantitative analysis of business processes w.r.t. sustainability, I aim to extend existing activity-based costing approaches by considering additional data, and leverage process simulation to arrive at a more accurate assessment.

In product design, the Life Cycle Assessment (LCA) method has been established in order to assess the environmental impact of different materials and products in a holistic fashion [2]. Using LCA, the impact of products or processes according to several measures can be determined and expressed in terms of numerical scores. Such an LCA methodology is well-suited to enrich existing sustainability analysis methods based on greenhouse gas-focussed activity-based costing, and provides a useful and actionable contribution when applied in a process-level setting. In detail, each activity can be assessed individually based on the LCA method and, for example, the relevant materials or resources involved in the execution. Additionally, based on the evaluation and scores of all activities, a measure indicating the overall impact of the process and its instances and variants can be determined. Here, the impact of activities and the process itself over the course of multiple process executions with different activity and process configurations can be assessed by using process simulation. Both individual and overall scores can then be leveraged to enable process redesign with a focus on improving sustainability and decreasing the environmental impact. It might also be feasible, in future work, to combine this approach with others that aim to optimize different metrics such as performance, service quality, or alignment with certain incentives (e.g., [3, 14]), to allow process redesign w.r.t. sustainability

while maintaining other desirable properties of the process. An interesting question could also be how these different perspectives should be prioritized and reconciled with each other.

4 Conclusion

This position paper discusses the need for facilitating a holistic analysis of business process sustainability than allowed by the existing works. With a combination of activity-based costing methods and data elicited through Life Cycle Assessment methods, a clearer understanding can be reached. This understanding can then be used to re-design processes with sustainability as the primary motivator.

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