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Using social sustainability principles to analyse activities of the extraction lifecycle phase: Learnings from designing support for concept selection

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ABSTRACT

Analysing product concepts with respect to social sustainability is a contemporary challenge for which there is little support available for product developers. Our aim was to build on previous work to support product developers in a case company with this challenge. We designed a first prototype of support for product developers to use a previously developed definition when analysing the extraction lifecycle activities associated with their product concepts. The prototype instructs users to model the location of the extraction activities and then use existing databases and indicators to analyse the social sustainability performance of each location. The databases and indicators were selected according to their relevance to scientific principles for social sustainability. We then performed initial evaluation of the support, through which we learnt that the approach may make it possible for product developers to analyse extraction activities, but the level of accuracy of analysis that is possible is not good enough for comparing the concepts in the case study decision. We discuss the implications of these challenges and suggest that it may be better to re-design our approach in order to provide learningful support for product developers or support for other decision-making in the company.

1. Introduction: the need for support

Sustainable product development is a young and rapidly developing field. However, much of the work has focused on reducing negative environmental impacts, while the social dimension has been less well-covered (Gmelin and Seuring, 2014). Socially sustainable product development is the processes and practices that lead to products whose lifecycles have a less negative impact on the social system. The weak coverage of socially sustainable product development mirrors the general sustainable development field, where the social dimension of sustainability has essentially been overlooked (Littig and Griessler, 2005; Partridge, 2005; Kunz, 2006; Cuthill, 2010; Dempsey et al., 2011; Vallance et al., 2011) and has been found to be lacking a clear theoretical concept (Littig and Griessler, 2005; Dempsey et al., 2011), a clear understanding of the meaning and interpretation of social sustainability (Weingaertner and Moberg, 2014) and clear indicators that help distinguish socially sustainable development from socially un-sustainable development (Omann and Spangenberg, 2012). Attempting to address these gaps, in previous work, one of the authors derived the following principles that together form a definition of social sustainability from the science of social systems (Missimer et al. in this issue a, b).

> In a socially sustainable society, people are not subject to structural obstacles to …
>
> 1. …health.
> 2. …influence.
> 3. …competence.
> 4. …impartiality.
> 5. …meaning-making.
>
> Structural obstacles refer to social constructions - political, economic and cultural - which are firmly established in society and upheld by those with power. Due to various kinds of dependencies and other factors, such obstacles are difficult or impossible to overcome or avoid for those affected by them.

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The newly derived definition of social sustainability - the social sustainability principles - is part of an established Framework for Strategic Sustainable Development (Broman and Robèrt in this issue, Missimer et al. in this issue a, b). This framework, including a definition of environmental sustainability and an earlier definition of social sustainability, has been used and improved for over two decades and in a variety of contexts (Broman and Robèrt in this issue). The (new) social sustainability principles have been used with preliminary results in strategic planning (for example, Missimer et al., 2014), but have not yet been rigorously developed and tested in the product development and concept selection decision realm. Others have worked with applying the previous definition of social sustainability from the framework in the product development domain. Examples include Ny et al.'s (2006) approach for strategic lifecycle management, Byggeth et al.'s (2007) method for sustainable product development and Hallstedt's (this issue) sustainability criteria. The new definition was more rigorously derived (Missimer, 2015) and thus, we wish to investigate how to help product developers use this better definition.

This paper covers a case where product developers were interested in understanding how they themselves could analyse product concepts with respect to social sustainability. They ultimately wanted to use this analysis to inform their concept selection decision-making. Selecting concepts occurs in the early phases of product development (Krishnan and Ulrich, 2001), when design freedom is high (Ullman, 2003) and when there is greater potential to reduce negative sustainability impacts (Bhamra et al., 1999). A product concept is an idea of a technical solution and associated features, working rules, attributes and customer benefits (Ulrich and Eppinger, 2012). Selecting concepts involves making trade-offs between various attributes of the concepts (Ulrich and Eppinger, 2012), for example, trading between initial cost, long-term brand image, functional performance and usage cost. Integrating social sustainability into these trade-off decisions may be part of a good process for supporting product developers to develop products that are more socially sustainable. The product developers in the case company were interested in exploring this. In particular, they wanted to analyse two aerospace engine components in order to understand and compare the social sustainability attributes of these concepts.

The case company were already starting to use the framework of which the principles are part (for example, Hallstedt in this issue, Hallstedt and Isaksson, 2013) and now they wanted to use it for this specific decision – concept selection.[1] Early in the development process is also when product developers may experience time-pressure. This time pressure is not a surprising result of the race for shortest time-to-market. The case company were therefore interested in *time-efficient* ways of using the social sustainability principles to analyse product concepts.

A much discussed collection of approaches for analysing products with respect to social sustainability, but that is not based on the social sustainability principles, is Social lifecycle assessment (SLCA). Challenges with SLCA are well captured in the literature (for example, Jørgensen et al., 2008; Benoît et al., 2010; Dreyer et al., 2010; Wu et al., 2014). A particular challenge for this case was that SLCA methodologies are used by SLCA researchers or experts and take a long time for even the experts to employ. Since the product developers in this case (and possibly in many other situations) do not have either the time or the expertise to apply SLCA and therefore SLCA was not appropriate for this study. The SLCA is also not based on the newly developed social sustainability principles that we and the case company wanted to apply.

Since existing support does not test the use of the newly developed social sustainability principles and, in some cases, does not address the needs of the time-pressed product developers at the case company to analyse their concepts, a knowledge gap remains. The research question that guided our study was:

> How might product developers at the case company use the social sustainability principles to analyse product concepts with respect to social sustainability?

To address this question, we developed a prototype of support and evaluated it in a case study context. The case that we used to explore this was an aerospace company who develop engine components. In addition, we focused specifically on developing support for analysing the extraction phase of the lifecycles of these two components. Our goal was to develop an early version of time-efficient usable support that the case company product developers could employ and test. We had anticipated that product developers could employ existing indicators and databases, but we found that was not the case. Our intent with this paper is to share the learning that we gained through pursuing this goal in order to address the above research question.

2. Research approach

This work is part of a set of studies that aim to support people and organisations to act in a more socially sustainable way, with a subset focused on supporting socially sustainable product development practice. These studies are together framed by design research methodology. Blessing and Chakrabarti's (2009) design research methodology comprises studies for (1) clarifying the research focus, (2) understanding the need and context, (3) developing support, and (4) evaluating the support and suggesting improvements. In the study captured in this paper, we (the authors) build on earlier work on the understanding of social sustainability (see Missimer et al. in this issue a, b) and of the case company context (see Bertoni et al., 2014; Hallstedt and Isaksson, 2013; Thompson et al., 2011). This study corresponds to the third and fourth studies of the design research methodology. In particular, we developed and evaluated a prototype of support for product developers to use the social sustainability principles to analyse product concepts.

In order to develop and evaluate support, we employed a prototyping approach. In line with a prototyping approach (Kelley, 2001), we iterated between designing and testing in order to learn quickly and early, and then to incorporate these learnings in the next design task. As we iterated, we reflected on what we were doing, how well it was working and whether it seemed like it would be relevant and usable by product developers in the given context.

For the testing, we used the prototype on an example case, which, according to Savin-Baden and Major (2013) and Yin (2009) enables more realistic evaluation. As an example decision, the case company provided a past selection decision between two concepts that differ only in material (and consequential attributes, such as thickness and manufacturing processes). In this paper, these concepts are referred to as concept A and concept B.

Testing was performed through two main activities. Firstly, as part of prototyping, researchers played the role of product developers and used the prototypes of support to analyse the extraction phase lifecycle activities of the two concepts. In line with Blessing and Chakrabarti (2009), this enables researchers to gain initial learnings about potential and issues without using actual

[1] Note that the case is not about re-designing concepts or other aspects, but focused specifically on the decision where they select between existing concepts.

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