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Strategic sustainability considerations in materials management

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ABSTRACT

Increasing awareness in business and society regarding socio-ecological impacts related to society's use of materials is a driver of new materials management practices. The aim of this study is to gain insight into what considerations come into focus and what types of solutions are revealed when companies apply a strategic sustainability perspective to materials management.

Through literature reviews and semi-structured interviews we found that the companies studied have assessed material choices and related management actions, not only regarding their potential to reduce a selection of current socio-ecological impacts, but also regarding their potential to link to future actions to move towards the full scope of socio-ecological sustainability. Through this approach, these companies have found several ways through which materials with characteristics that are commonly considered problematic can be managed sustainably by making strategic use of some of these "problematic" characteristics and other characteristics of the materials. For example, a material associated with problems at end of life, could be managed in closed loops facilitated by the persistence of the material. Based on the findings, we conclude that by not applying a strategic sustainability perspective to materials management, organizations risk phasing out materials perceived to be unsustainable which, managed differently, could be helpful for sustainable development.

1. Introduction

All ecological and many social sustainability problems are directly or indirectly related to materials and material flows. Negative impacts occur throughout the materials' life-cycles from extraction through transport, production, use and disposal of the materials. This is true also for sustainability problems related to society's current use of energy. It is not the energy use in itself that creates the sustainability impacts, but the accompanying flows of matter.

The implications of unsustainable materials management cover a wide variety of aspects. Examples include clear cutting and strip mining at the sites of sourcing, pollution and waste generation from production and end of life treatment, and degradation of social systems by, for example, improper working conditions amongst suppliers.

Socio-ecological impacts related to materials management vary from case to case, as do the options for appropriate measures. The focus of research is often on specific material characteristics, on the origin of the materials, on recycling of materials or on the embodied energy of materials (Moore and Ausley, 2004; Richards, 2006; Niinimäki and Hassi, 2011; Álvarez-Chávez et al., 2012; Rajendran et al., 2012). Other researchers apply a broader systems perspective, including visioning of material flows in a prototypical company of the 21st century and material flow modelling including the planetary environment and the economic system (Geiser, 2001).

The variation in research is also reflected in how sustainability aspects are considered in decision support tools used in product development. Some support tools focus on specific aspects such as embodied energy, toxicity and recyclability (Ashby, 2001) while other support tools consider a broader set of environmental properties, eco-attributes or eco-profiles (Karana et al., 2008). However, even though there are many different tools available, companies experience difficulties regarding how to implement strategies for sustainable materials management in their decision process (Abdul Rashid, 2009; Thompson et al., 2011). The lack of a more holistic sustainability perspective on the most commonly applied tools and the strategic insufficiencies that follow from this have been pointed out in several studies (Byggeth and Broman, 2001; Robèrt et al., 2002; Byggeth and Hochschorner, 2006; Thompson et al., 2011).

Previous studies on sustainable life cycle management and sustainable product development (Byggeth and Hochschorner,

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2006; Ny et al., 2006; Byggeth et al., 2007; Ny et al., 2008; Hallstedt et al., 2010) have shown that a framework for strategic sustainable development (FSSD) is helpful in bringing about a perspective that is large enough in time and space (future sustainability for the global civilization). This framework is designed to help organizations manage the complexity of sustainability and find economically viable pathways to comply with a robust principled definition of sustainability. The FSSD enables the organization to find aspects of current activities that are critical from a socio-ecological sustainability point of view, to envision solutions that aid compliance with a principled definition of sustainability, and make prioritizations amongst those into action programs. For a brief description and references, see the next section.

Through this study, we aim to gain further insight into what considerations come into focus and what types of solutions are revealed when companies apply the FSSD specifically to materials management.

2. Framework for strategic sustainable development

The FSSD is built on the understanding that, to be able to plan and act strategically, it is essential to have a robust definition of the objective. Only with a sufficient understanding of the objective is it possible to adequately deal with system boundaries and trade-offs, select adequate tools for the transition, calculate sustainable resource potentials and cooperate across sectors and disciplines (Robèrt, 2012).

The FSSD comprises five levels, each used as a reference point for sustainability analyses (Robèrt, 2000; Robèrt et al., 2002). The levels are described briefly as follows:

The system level – a description of the topic with its nested subsystems within society in the biosphere;
The success level – success for the topic, that is, in this case, sustainable materials management, informed by basic principles for sustainability;
The strategic guidelines level – guidelines for stepwise approaches towards compliance with the defined success;
The action level – concrete actions aligned with the strategic guidelines and put into a plan for compliance with the defined success; and
The tools level – concepts, methods and tools to support and monitor the transition between the current situation and the defined success.

The principled definition of sustainability, used within the success level, is (see, e.g., Robèrt et al., 2012):

In the sustainable society, nature is not subject to systematically increasing…
…concentrations of substances extracted from the Earth's crust (e.g., fossil carbon and heavy metals);
…concentrations of substances produced by society (e.g., nitrogen oxides and persistent organic pollutants);
…degradation by physical means (e.g., by deforestation and overfishing).
And in that society…
…people are not subject to conditions that systematically undermine their capacity to meet their needs (e.g., by abuse of political and economic power).

The fourth principle is currently under development to explore a subset of principles that are more operational and easy to monitor progress along (Missimer, 2013).

The overarching guideline for organizations to support society's compliance with these principles is to integrate them with the objectives of the organization, that is, apply the sustainability principles as boundary conditions for redesign of visions and objectives, and then backcast (Dreborg, 1996; Vergragt and Quist, 2011) from that integrated overarching goal. It means a stepwise approach, ensuring that early steps are designed to serve as (i) flexible platforms for forthcoming steps that, taken together, are likely to bring the organization to the defined success, by striking a good balance between (ii) direction and advancement speed with respect to the defined success and (iii) return on investment to sustain the transition process. In addition, a sustainability strategy benefits from openness achieved through transparency, dialogue and influence throughout supply chains. For further description of the FSSD, see, for example (Robèrt et al., 2012).

3. Design and conduct of the study

The screening for suitable cases for this study was performed by interviewing representatives of organizations known for proactivity when it comes to sustainability. This resulted in a pool of cases that were investigated further. After evaluating the candidates, five cases were selected. The selection criteria were: (i) if the case was clearly related to different aspects of sustainable materials management, and (ii) if the case was clearly associated with the use of the FSSD. Data for the cases was collected through literature reviews and semi-structured interviews with people working as consultants, product developers and company managers with and within the selected organizations. The following questions were used to guide the literature review and the semi-structured interviews for each case:

1. Describe a specific case where material selection from a strategic sustainability perspective was done.
2. What was the driver that led to this case?
3. How did you define a successful materials selection?
4. What aspects were used to assess the different materials choices?
5. What strategies were used to manage the material in a sustainable way?
6. How did the FSSD help you in this work?

The following organizations participated in the study: Hydro Polymers, Rohm and Haas, InterfaceFlor, Electrolux, Max and The Natural Step (an NGO for strategic advice on sustainability). The findings, reported below, were validated with the respondents.

4. Sustainability considerations in materials management

4.1. Hydro Polymers – how to manage Poly Vinyl Chloride in a sustainable way

The material Poly Vinyl Chloride (PVC) is a thermoplastic with many applications. It has been subject to intensive critique from, for example, environmental organizations, in particular with respect to emissions of persistent organic pollutants and heavy metals used to stabilize the material during thermal compounding and processing.

To find out what it would take to make PVC sustainable, Hydro Polymers initiated a gap analysis, guided by the FSSD, which was conducted in a multi-stakeholder dialogue including the Environment Agency in the UK, The Natural Step in the UK and representatives from industry, retailers, Greenpeace, Government and science. The multi-stakeholder dialogue found that from a strategic sustainability perspective there are many conflicting aspects linked to PVC, including (Leadbitter, 2002; Everard, 2008):