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## **ACTIONABLE KNOWLEDGE TO DEVELOP MORE SUSTAINABLE PRODUCTS**

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### **ABSTRACT**

Companies need to develop more sustainable products to fit into more sustainable future markets, and there is need for ways to guide towards and compare sustainability already early in material or product development. How this can be handled has been studied through action research in a material development project aiming to develop wood-based materials to replace petroleum-based materials while ensuring a more sustainable product. A specific focus was put on creating actionable knowledge to facilitate innovation towards more sustainable products by translating and integrating significant product sustainability characteristics into each team member's specific area of expertise and everyday work. The insights are now used in different other on-going projects in a textile industry setting and in relation to companies' management systems.

### **INTRODUCTION**

In order to stay in business in the long term, companies need to develop and offer more sustainable products. Achieving this involves many different considerations, such as impacts on the resource base, on climate and many other challenging aspects of human society as well as global market issues, like stakeholder interests, patents and policy instruments.

Literature on development of more sustainable products focus on different areas such as on raw materials, technologies, environmental impacts, customers' needs, scenarios as well as the company strategies and code of conduct. The complexity of developing more sustainable products requires many skills. Actionable knowledge (Argyris, 1996) is the knowledge that informs us of how to create and integrate these different skills into, in this case, a more sustainable product. It is, however, common to get stuck within a specific knowledge area or a way of working and only such new knowledge that can be seen as developing the expertise or the way of working is taken in and used. In addition, quality and sustainability staff functions have a tendency to do their job more 'in theory' than having a real 'in action' influence on value adding processes in their organizations (Book, Alänge, & Solly, 2006).

This short paper reports on insights and experiences gained from a research collaboration between industry and university, aimed to develop new wood-based materials that can replace non-renewable materials in products, while ensuring that the new product is also more sustainable than the reference product. The paper also describes further work around actionable knowledge, i.e. on providing useful and relevant knowledge for actors developing products, to facilitate the innovation of more sustainable products.

## **RESULTS & DISCUSSION**

### *Review of sustainability assessment methods*

A literature survey was carried out on sustainability assessment tools used today with emphasis on assessment parameters for comparing petroleum and wood as material resources. The survey was contrasted with the needs in a specific project. Existing gaps in knowledge were evaluated and further steps that needed to be taken were identified. The survey, analysis and results are reported by Clancy, Fröling, & Svanström (2013a) and a selection of the findings is presented below.

A diverse number of tools that can assess different attributes of product sustainability for parts of or whole product life cycles exist, like LCA (Life Cycle Assessment), Ecological footprint and SocioEcoEfficiency Analysis (SEEBalance). Clancy et al. (2013a) list elements of different methods that can be of use in a product sustainability assessment throughout a material development project. The methods identified are normally only suitable for comparing similar types of products or similar sets of impacts, while there is a lack of frameworks for dealing with sustainability impacts that are fundamentally different in character. One example is the comparison of using either renewable or non-renewable material resources, a situation which none of the methods can handle satisfactorily. Available methods mainly rely on quantitative data, thus, preferably assessing existing products with defined product systems and measured process data available. The analysis also identified a lack of product sustainability parameters on social progress and on impacts on ecosystem services, such as biodiversity.

### *Guiding in early product development – insights from action research*

To gain a deeper understanding of the requirements and barriers in guiding product development towards a more sustainable product, experiences from work performed in a material development project were analysed and complemented with information from a literature survey (Clancy, 2012). Three often unstated fundamental conditions in assessing product sustainability in early product development were revealed:

- Product sustainability considerations are case specific and, hence, need to be established for every situation.
- Sustainability assessment implies a future-oriented assessment and no-one knows what the future will look like.
- Product development implies that the product system is under development and not yet clearly defined.

Various activities were performed within the project to provide input to the development of the process (guiding product development) as well as to provide input to the assessment itself. Experiences from such activities emphasise the challenges involved in interacting with the

development team, e.g., in terms of motivating the team and in providing meaningful information to the team. The challenge of motivating and the difficulty in comparing different types of considerations verify the importance of having a shared vision and establishing relevant sustainability considerations for the specific case. Based on the analysis of the action research and available literature, a team-learning process for establishing sets of relevant product sustainability parameters was developed (Clancy, Fröling, & Svanström, 2013b). The suggested process emphasises the need of a shared vision and establishing relevant sustainability considerations for the specific case that are translated and integrated into practical meaning for every co-worker's daily work thus making the knowledge actionable.

#### *Early estimates of product environmental performance*

In one of the efforts to guide development within the project, an LCA approach was applied to visualise environmental challenges to team members already in early phases of the material development work (Clancy, Fröling, Peters, & Svanström, 2010a). The LCA visualisation showed that, unless there are positive impacts in other areas that can compensate, environmental impacts from the production of the new material must be rather low if the product using the new material is to be more environmentally benign than the reference regarding most of the common environmental parameters. In particular, performance in terms of energy demand proved to be a challenge for the new material. The findings clearly illustrate the importance of the material development team's awareness of important sustainability considerations for the product in development.

#### *Considering resource limitations for wood-based products*

The understanding gained in earlier reported work (Clancy, 2012; Clancy, Fröling, & Svanström, 2010b) is now taken further in a study of the choice between different bio based raw materials for textiles. The vast environmental, social and health issues connected to conventional cotton and the increased consumption of textiles has resulted in that the forest industry is putting efforts into developing wood-based textiles. Forest area and yield is, however, a limited resource. Much of the annual global yield is already utilised, e.g. for timber and pulp and paper production, and there is an increasing demand for bio-based fuels and materials for replacement of petroleum-based ones. The increasing competition for the biological production from the forests and the land area results in rising concerns regarding biodiversity and other ecosystem services. It is thus important to estimate future global demands on forestry and to visualise the results for the strategy and development departments, using scenarios, how biomass/wood can be used in a responsible way in products for the future. Such visualisations are being created in an on-going project. The aim is to create actionable knowledge so that companies' can navigate in a sustainable way.

#### *Ecolabels as apparel information carriers to designers and customers*

The problem of providing meaningful information to different actors is the starting point for another on-going investigation looking into the connection between ecolabels and the design process of clothes. The analysis, so far, shows that there is currently very weak connection between ecolabels and designer's work. The lack of connection is mainly due to that ecolabel criteria focus on ecological and social considerations in the supply chain and rarely has criteria on product level such as life span or aspects of use. This work confirms the earlier insight, that developers need actionable knowledge to see the link between their work and the

sustainability impact of the final product, which is not provided to designers by current ecolabelling systems.

#### *Understanding organisation for successful change*

A shared vision in the development team is vital when developing more sustainable products, as discussed above. To successfully integrate a shared vision or to affect a changed behaviour, such as increased sustainability thinking in a company, requires understanding of how change can be created in the company and how the specific company's management system influences behaviour. In order to increase this understanding, a comparative study has been initiated of how sustainability is integrated into product development in two large international firms and how this integration is influenced by their management system. Preliminary findings show that the ways of creating sustainable products can be very different because of companies' history and specific management systems, which indicate that what is actionable knowledge may differ between different organizations.

### **CONCLUDING DISCUSSION**

Sustainability entails a long-term commitment to and focus on the needs of coming generations, which conflicts with the normal time perspective of 1-10 years in the long-term planning procedures of companies. Approaches are thus needed that facilitate the integration of sustainability considerations, including long-term considerations, into material and product development processes before decisions that will have a profound impact on the sustainability performance of the final product are made.

Actionable knowledge is the type of knowledge that enables the creation of more sustainable products. The studies presented above all aim at contributing to actionable knowledge by identifying strengths and improvement areas and by suggesting ways to visualize and raise team's and individual's practical understanding and ability to develop sustainable products.

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