Chapter 14
From *Waste to Value*: A Story About Life Cycle Management in the Furniture Industry

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Abstract This case focuses on the use of the CapSEM Model by the Norwegian furniture industry, beginning with efforts that raised sustainability awareness through a series of case studies over a period of more than 10 years. It started with a Cleaner Production (CP) programme for a group of furniture companies in a small community. The goal for another case study running in parallel with the CP-project, was to define a common set of Environmental Performance Indicators (EPIs) for reporting purposes for both the companies and the municipality to reduce waste and improve its treatment according to circular principles. While CP is at Level 1, EPIs and reporting is on level 3 and 4 in the CapSEM Model. In the furniture sector, the CP-programme led to capacity building by integrating Level 2 methods such as Life Cycle Assessment (LCA) into their daily work processes. LCA was used for product improvements based on hot spots detected through the analyses, and also to generate Environmental Performance Declarations (EPDs) for products. The implementation of these new procedures was integrated into the organisation's strategic work through certified Environmental Management System (EMS). In addition to a demonstration of a gradual shift from Levels 1, 2 and 3, the case also describes the benefits of building cooperative communities (Level 4) that include sectoral, regional, and academic participants. The Level 4 activities were originally initiated by a Norwegian Local Agenda 21 programme.

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14.1 Introduction

Small and medium sized enterprises (SMEs) are often neglected in studies on industrial impacts on the environment (von Geibler et al. 2004), despite the considerable overall environmental impact from SMEs. One challenge facing these companies is limited resources and knowledge, which is also often not prioritized since they tend to perceive their own contribution as negligible in the absence of any prior quantification (Ammenberg and Hjelm 2003). However, this is about to change with increasing demands for documentation on both company and product environmental data and information from society and the global marketplace.

The furniture industry in Norway is an industry dominated by SMEs (Michelsen 2006). Manufacturers are dispersed throughout the country, with a higher concentration in western regions. Several suppliers are located here too, forming an ecosystem of companies at least partially mutually dependent on each other (Michelsen 2006). Fet and Johansen (2001) presented the development of an environmental awareness within the Møre and Romsdal region. This case focuses on how starting from this raised awareness through cleaner production (CP) affected the environmental policy and strategy within the companies and how this resulted in an extensive use and implementation of life cycle assessments (LCA) and development of environmental product declarations (EPDs). This is presented through a collaborative project performed in 4 phases.

14.2 The Furniture Case Project

Phase 1: The Process Focus
Research activities focused on environmental challenges within the furniture industry have a long history. Initially the focus was on cleaner production (CP) in a group of furniture companies with the goal of reducing wastes and emissions through the principles described for CP in Chap. 4 in this book. In parallel, a programme was running with the purpose of identifying appropriate environmental performance indicators (EPIs) for environmental reporting of waste streams and waste treatment within the companies and the municipality where manufacturers were situated (Fet 2000; Fet and Johansen 2001). During these projects, the focus was on companies' environmental performance and the potential for cleaner production processes, consistent with building capacity from Level 1 in the CapSEM Model. As the municipality with the waste treatment plant collaborated closely with companies to find appropriate EPIs for reporting and for following up waste streams, it can be said that Level 4 activities also took place in phase 1. For the purposes of this case, it was possible to continue the transition to sustainability and move from Level 1 to Level 2.

Phase 2: The Life Cycle of the Products

The focus gradually expanded and shifted to assessments of extended supply chains for selected products (Michelsen 2006, 2007a, b; Michelsen et al. 2006). At this time, several LCAs were performed to get an overview of the environmental impacts of the materials used in the products and identify areas for improvements. This was partly carried out with learning in mind; how much detail can be included in environmental performance documentation, what are the environmental hot spots, what are the differences between equivalent products or products with the same functional unit, and, importantly, how can this be communicated.

Since most furniture producers had a large range of product models and variants of the products, an environmental life cycle inventory database for furniture production was created to ease the generation of life cycle assessments of the models (Fet and Skaar 2006; Fet et al. 2006). To ensure the consistency of the performed LCAs and the possibility to compare products, a first version of Product Category Rules (PCR) for furniture was also proposed (Fet et al. 2006). PCR define the criteria for a specific product category and sets out the requirements that must be met when preparing an EPD for products under this category (Fet et al. 2009). The database was used to carry out a large number of LCAs, including those conducted by Michelsen (2007b) where the importance of the different suppliers was assessed.

For companies, it was also important to document indoor emissions of toxic substances that could have a negative effect on human health during the use of the products. This is normally not part of an LCA but was included here to cover other reporting requirements the furniture producers face (Skaar and Jørgensen 2013). The end result of this second phase was a standardised PCR as foundation for EPDs. For companies, it was also important to document indoor emissions of toxic substances that could have a negative effect on human health during the use of the products.

Phase 3: Integration in Environmental Management Systems

A third phase focused on a stepwise framework based on systems engineering principles (Skaar 2013) to be integrated in the environmental management system of the company. The framework consists of six steps, from stakeholder identification, to publishing EPDs and finally auditing the process, see Fig. 14.1. This builds on the same principles as presented in Chap. 12.

A major barrier to scaling up the number of products that could be assessed was the resources needed to develop each EPD, (step 4, Fig. 14.1). The third phase addressed this barrier through the development of the LCA database and EPD software tool. This resulted in a significant reduction in the resources needed to develop an LCA, as a shared database means common background data are only gathered once. It also made it possible to simplify the EPD generation, using a bill of materials (BoM) approach. This meant that instead of an LCA expert developing the EPD, the companies could take responsibility for major parts of the process. With a database and tool in existence, the company could enter a limited number of information to create an EPD: (i) the bill of materials for a product, (ii) specific production data for the product, and (iii) selecting relevant scenarios (e.g., which market it was sold

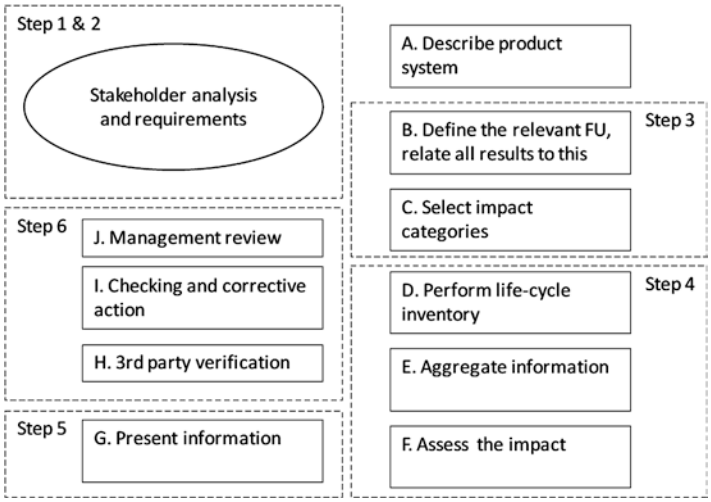

Fig. 14.1 Framework for management and communication of environmental aspects of products. (Skaar 2013)

to). Based on this, an EPD could be developed based on step D to G in Fig. 14.1, and the verification of the EPD could be done by a simplified third-party verification of the database.

The approach developed in phase 3 does not in itself ensure environmental improvement for the products, but it is a basis for integrating life cycle assessment as part of the environmental management system as a tool for improvement. For the life cycle management (LCM) of products, this further supports progression to Level 3 on the CapSEM Model.

Phase 4 – From Environmental Management to Life Cycle Management
The three first phases followed each other in a logical and chronological order; the fourth and last phase ran parallel with the previous phase 2 and 3 and gradually matured. The information gained from environmental analyses of production processes and the life cycle of the products enabled companies to make strategic priorities of improvements targets regarding the most significant aspects.

In Michelsen et al. (2006), different products and potential improvement options were assessed using an eco-efficiency approach, combining information from LCA and life cycle cost assessments. This was done in order to explore the environmental and cost profiles of the models, as well as to start assessing potential improvements for the different models. Figure 14.2 shows the relative eco-efficiency for the models where single scores are used, while Fig. 14.3 shows the relative environmental impact divided in different environmental impact categories.

Figures 14.2 and 14.3 show the total (aggregated) scores for the products, but often it is also necessary for the focal company to know where in the supply chain the impacts occur in order to actually address them. Clift and Wright (2000) identified a tendency that the profit is concentrated towards the end of the production chain, while the environmental impacts are concentrated towards the front part. In other words, those actors who make the most profit are not the same as those having the largest challenges to reduce the environmental impact of the final product. This might be a result of outsourcing challenging processes. However, when the product as such is addressed, this must consider the supply chain as a unit. This clearly highlights the need to move from the first level in the CapSEM model to higher levels; i.e., observed Level 1 improvements can potentially be a product of outsourcing, not product level improvements.

Michelsen et al. (2006) found a similar pattern during their assessments, where the environmental impacts primarily originated from activities at suppliers and/or in the end-of-life phase. One exception was impacts from phytochemicals, originated from the varnishing process which the end-producer addressed in-house (Fig. 14.4).

In order to actually improve the environmental impacts up- and downstream, the focal company must know who the actors are and have the ability to make them change the processes or inputs (Michelsen 2007b). Communication and a common understanding of the goal is thus essential. This could be a significant undertaking job in complex supply chains, but Michelsen (2007b) showed that a limited number of the suppliers were responsible for most of the environmental impact. In fact, a

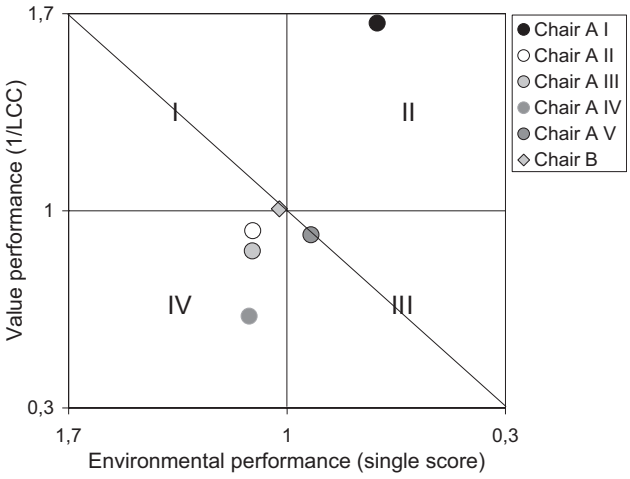

Fig. 14.2 Relative eco-efficiency for 6 different products using an aggregated single score for environmental impact. (Data from Michelsen et al. 2006)

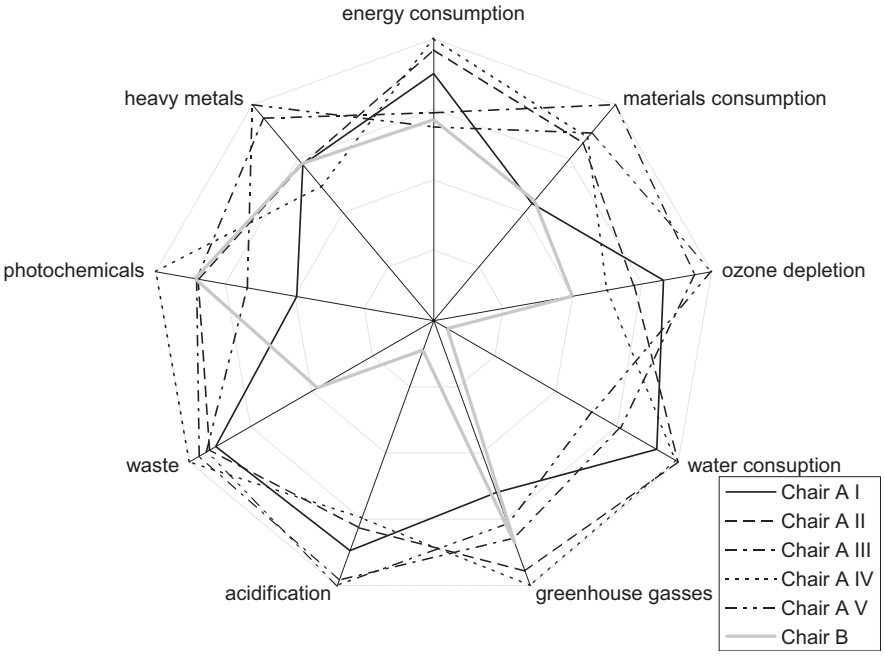

Fig. 14.3 Relative impact on different environmental impact categories for 6 different products. (Data from Michelsen et al. 2006)

chair designed for institutions for elderly care, found the four most important suppliers where responsible for 82.6% of the upstream environmental impact, see Fig. 14.5. One of these was even a subsidiary company and the most important, a producer of polyurethane foam, was a neighbouring company also involved in the local project on improving environmental performance in the region. The fourth phase concluded with recognized possibilities for strategic management of the supply chain in order to improve the performance (Fet and Michelsen 2010) and also move from the first to the third level in the CapSEM Model.

14.2.1 Drivers

There have been three drivers for the successful development of environmental awareness and improvements in the furniture industry resulting from this project.

First, there was already a local initiative for environmental performance in the local community (Fet 2000; Fet and Johansen 2001). The furniture industry is at the cornerstone of the local industry and had a natural role in the initiative from day one.

Second, the long-time relationships between the furniture producers and their (local) suppliers have resulted in strong bonds and the shared perception of a

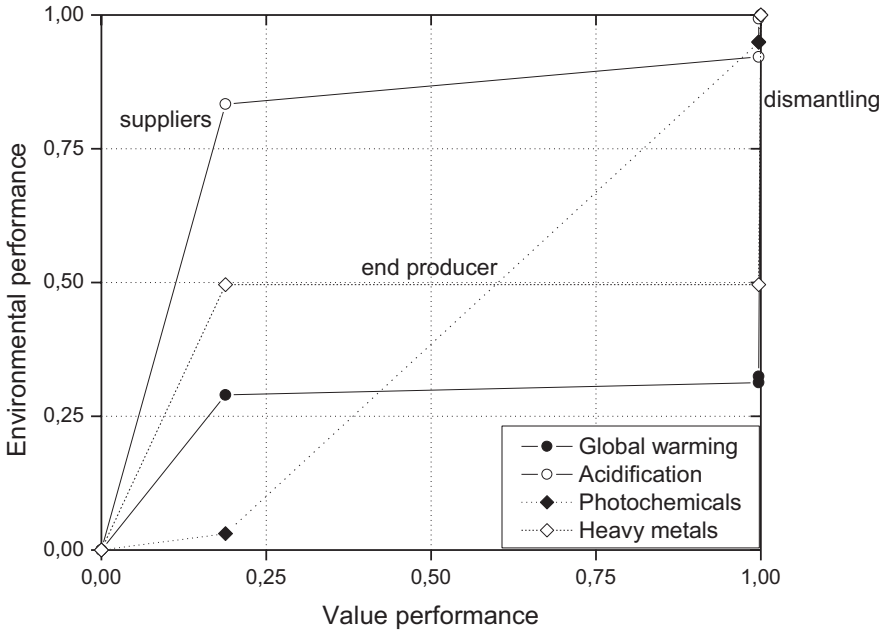

Fig. 14.4 Relative contribution of value performance and environmental performance from suppliers, end producer and dismantling of a chair. (Michelsen et al. 2006)

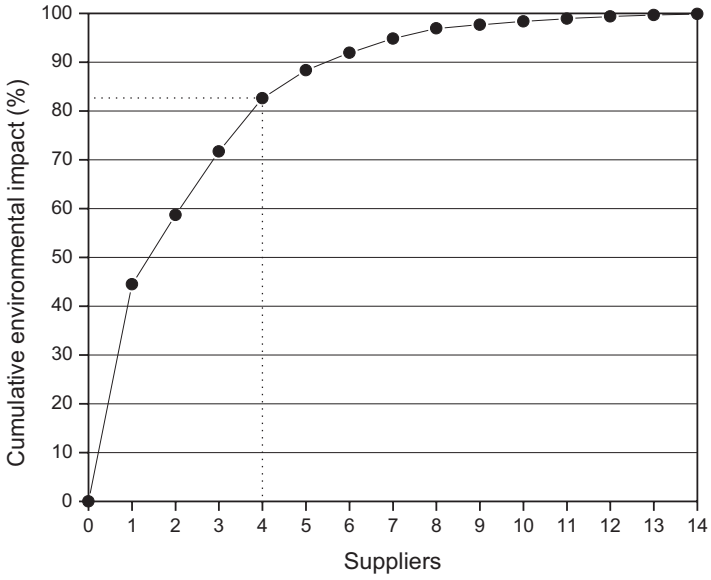

Fig. 14.5 Cumulative environmental impact related to the number of suppliers. (Michelsen 2007b)

common destiny. They were devoted to help each other to perform better as a cluster, not only as single companies. This applied to the furniture producers, who even if they at first glance could be seen as competitors, shared the view that their main competitors are furniture producers in low-cost countries (Michelsen 2006). This fact made the development of a common database for environmental data much easier since the companies involved trusted each other.

The third driver was pressure from outside. The furniture producers are exposed to an increasing demand for environmental information on the products, in particular from public purchasers (Michelsen 2007b; Michelsen and de Boer 2009). They were consequently highly motivated to cooperate with the research activities and provide available data, e.g., the prospects of an improved image for marketing purposes had motivated the manufacturers (Fet 2002, 2004). The streamlined process for EPD-generation for products enabled the furniture producers to provide the requested documentation to public purchasers and then increase marked shares when EPSs were required.

14.3 Concluding Remarks

As addressed in the introduction for this chapter, SMEs often lack competence and resources to systematically work with and improve environmental performance at the process, product and company levels. In this particular case, this need for competence was met through the collaboration through the four phases of research projects with research institutions. The companies thus increased their possibilities to initiate and consolidate their own work on environmental performance. It was also advantageous that the projects continued for more than a decade, as this provided longitudinal feedback to the researchers. The companies during this period were able to establish environmental management systems and were able to integrate the generation of LCAs and EPDs in their everyday activities. As described, the companies have included this in their environmental management systems, approved by top management in the companies. They have succeeded in making this a part of the companies' strategies.

It remains an open question as to whether this could have been accomplished without the long-term collaboration with research institutions. Nevertheless, it stands out as obvious that the collaboration between the companies, both the furniture companies themselves but also their suppliers in the municipality in the region, have been a prerequisite for establishing a common database and thus lowering the bar for performing LCAs. By doing this, companies have collectively been able to expand their environmental focus from process and company-oriented assessments to a product life cycle focus. The generation of and insight in EPDs has given them a competitive advantage.

As also described, the furniture companies have been enabled to identify the suppliers that are most significant for the overall performance of the products. It is still an open question whether they have been able to fully utilize this knowledge in

improvements of products, but the presented case study shows that the number of suppliers with significant contributions at least for some products is low and consequently manageable.

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