Eco-Performance in the Life Cycle of Shoe Production

Tobler - Rohr Marion I.

Institute for textile machinery and textile industry, ETH Zurich, Switzerland
e-mail tobler@textil.bepr.ethz.ch

Introduction

Environmental impact assessment follows the defined procedures of scale and scope definition, inventory, assessment and evaluation. Especially the first step is essential for the design of a case study and requires careful considerations of a functional unit (Heijungs 1992). The degree of aggregation of the results (Müller-Wenk 1996) is not only a point of discussion between natural sciences and business administration but also a question of communication, based on specific knowledge of the people involved. Additionally, if the interpretation shall be accepted by a technical point of view, the results have to be comparable to Best Available Technology (BAT). This aspect is often missing in case studies. Moreover, in the existing tools conditions for the implementation of improvements are hardly ever investigated scientifically (Beck and Bosshard 1995), although in real life these facts are of great importance to the Eco-Performance of a company (Dyllick und Schneidewind 1995). Environmental Management Systems (EMS) require increasing the environmental awareness of human resources (Lalive d'Epinay 1991, Rosenstil 1991) as a central issue.

This case study aims both at environmental and technical impact evaluation and the evaluation of human potential for improvement in Eco-Performance. By combining the findings of these researches, proposals for implementation in the company are elaborated, taking into account the aspect of communication.

The given system, the life cycle of shoe production ("from cradle to grave"), is investigated in order to allow allocation not only of impacts caused by the fabric in its life cycle but also of the suppliers involved.

Design and Methods

Design

The aim of the investigation required a specific design based on methods of social and environmental science, whereby existing and new methods were used. The study is divided into three parts (see fig. 1). First, an inventory in social sciences is collected, investigating attitudes and behaviour of over fifty employees towards economic, social and environmental issues by means of focussed interviews.

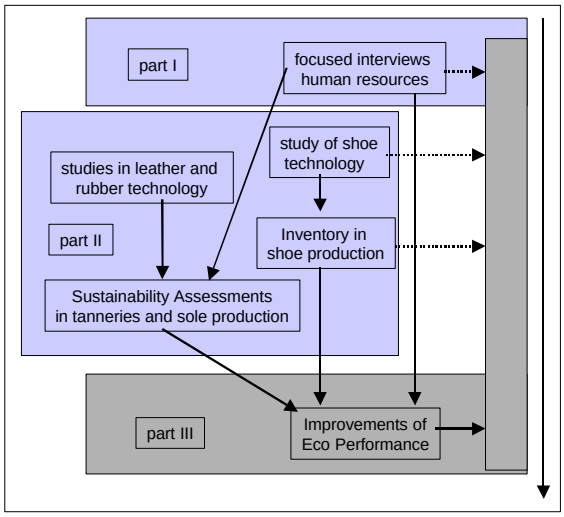

Fig. 1 shows the design of the study

In part two, technical and environmental impact assessment of the system is carried out (see fig. 2). From more than 400 articles (men's shoes), six representative product lines are selected. A life cycle screening (not shown in this paper), comparable to Schmidt Bleek 1993, indicated that main impacts are caused by leather and sole production. Consequently, technologies and environmental indicators of these areas are evaluated (Tobler 1996).

For the Eco-Performance of the product lines, two methods for assessment are developed and the results combined with economic driving factors of the company.

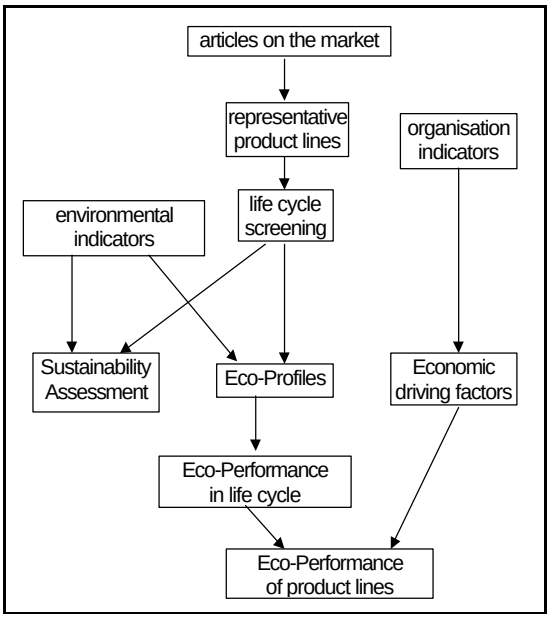

Fig. 2 shows the method for impact assessment

Based on the same inventory, the Sustainability Assessment is technology and process oriented and therefore suited for communication with technicians in the supply (tanneries and sole production), while the Eco-Profiles give strategic assessment for communication with the management (see fig. 4).
In part three, the findings of the focused interviews are combined with the results of the Eco-Performance (part two) in order to make proposals for improvements (implementations).

Methods
In order to get as many inputs as possible, a method from qualitative social science, the focused interview (Lamneck 1988) was chosen. The interviews were recorded on audiotape and fully transcribed. The collected data was inductively organised and grouped in categories, allowing classification according to the aims to be perceived. This procedure is carried out several times until the material fits in the categories, whereby best possible homogeneity and distinction of the categories is achieved. Such results show preferences in the interview partners' point of views and are not representative as results gained from standardised quantitative methods. The next step consisted of theoretical work for comparison with literature, and was conducted with the results themselves.

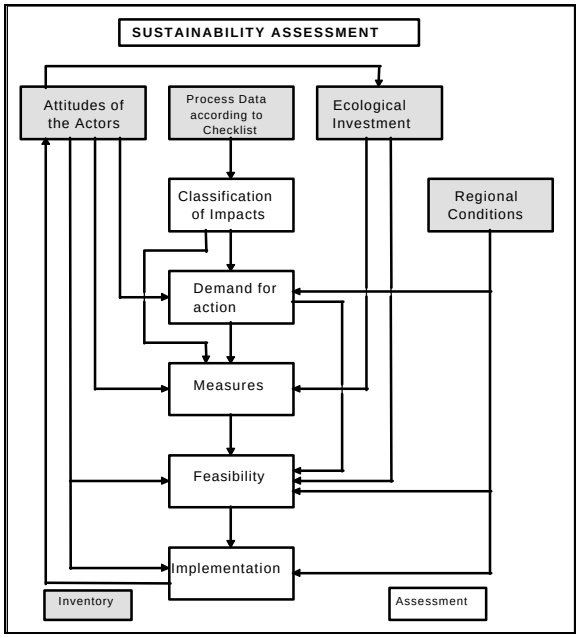

Fig. 3 shows the proceeding for the Sustainability Assessment

Indicator	**Impact category**	**Options (->SA)**	**Strategy (-> EP)**
H_2S-emissions in atmosphere	safety and health		
sulphides in effluents	local substance flux		
	biodiversity and landscape		
		oxidation of sulphides (with $MnSO_4$)	reduced harmfulness (sulphates in effluents)
		precipitation with iron	reduced harmfulness (hazardous waste)
		sulphide-recycling	recycling
		enzymatic treatment	substitution

Fig. 4 Evaluation of impacts with both methods: process oriented (SA = Sustainability Assessment) and strategy oriented (EP = Eco-Profile).

In the Sustainability Assessments (SA), production processes and technologies as well as social data are analysed and classified according to five impact categories (global chances G, local substance fluxes L, biodiversity and landscape B&L, safety and health S&H and resources R), indicating the degree of demand for action. The demand for action is adjusted to specific frame conditions (e.g. waste treatment of a community). Measures for improvements are proposed, and their feasibility is evaluated (see fig.3). In the Eco-Profiles (EP), the impacts obtained from the SA's are ordered into groups of strategic environmental parameters. The results are compared to Best Available Technology (BAT) in the given situation.

Results

Part I

Detailed results are shown in Tobler 1996. Summaries of the answers suggest that economic difficulties of the company are

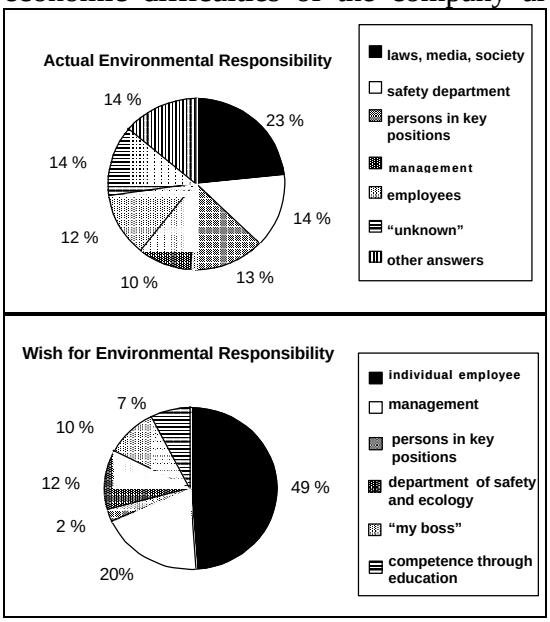

Fig. 5. Employee's awareness of environmental responsibility.

mainly due to internal circumstances such as changes in the organisation of work, differences in communication culture, lack of competence and contradicting decisions. Environmental knowledge, essential for the implementation of sustainable development in the company, has to be considered insufficient, while the awareness of environmental impacts is considerable. The willingness to improve environmental performance by means of personal actions is high (see fig. 5).

Part II

The results of part two are given by means of two methods. The Sustainability Assessment has been developed for communication with technicians focussing on process technology (see methods). Although the short version presented (fig.6) does not reveal all details, the differences between demand for action and feasibility of measures is obvious even in a "Eco"-line.

Indicator Process	Impact	Value	Action demand	Measures	Feasibility
long distance transports	G L R	2 3 3	great	reduction of transports	**1-2**
purchase of wet blue	L S&H B%L .	1-3 1-3 1-3	urgent	controlled wet blue production	**3**
salted raw material	L	4	low	iced rawmaterial	**2**
high amount of effluents	L B&L	3 3	low	recycling in beamhouse	**5**
AOX for water repelling	L G	3 3	medium	subsiding	**4**

Fig. 6. Sustainability Assessment for the product line "Eco". Lower numbers indicate higher impacts and lower feasibility.

For communication with the manufacturer, the Eco-Performance of product lines is elaborated. The Eco-Performance of the six product lines bases on Eco-Profiles of the main areas tanneries, sole production and shoe manufacturing (see fig. 7).
All EPs are added to the Eco-Performance in the life cycle (fig.8) and thereafter combined with economic driving factors.

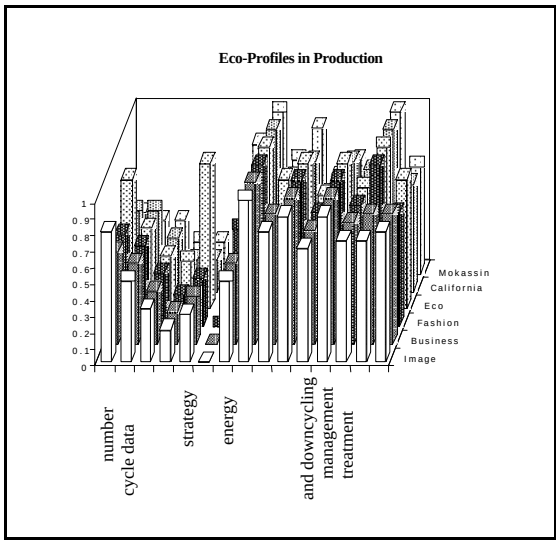

Fig. 7. Eco-Profiles of the six product lines

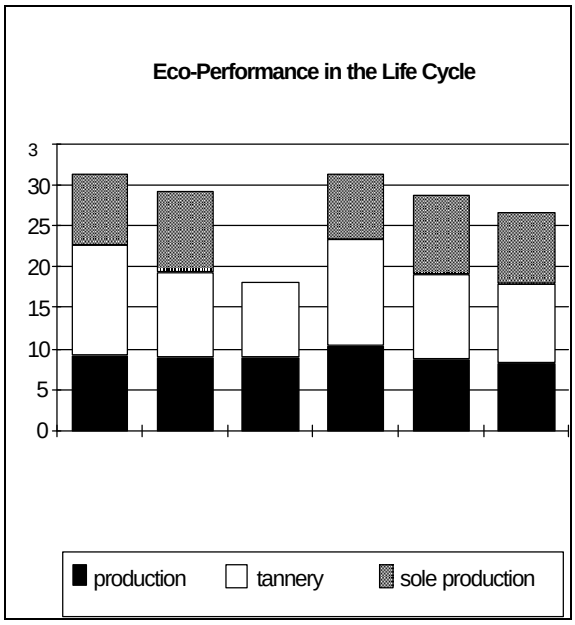

Fig. 8. Eco-Performance in the life cycle (data for sole production of the product line "Fashion" were not available)

Key factors for the improvement of Eco-Performance are economic driving factors such as calculation, purchase and marketing strategies, creation (design), quality standards, and the production technology determined by the organisation, especially product development in the company (see fig 2).

Since the balancing of economic driving factors against the Eco-Performance in the life cycle does not have a scientific base, these results will not be shown here.

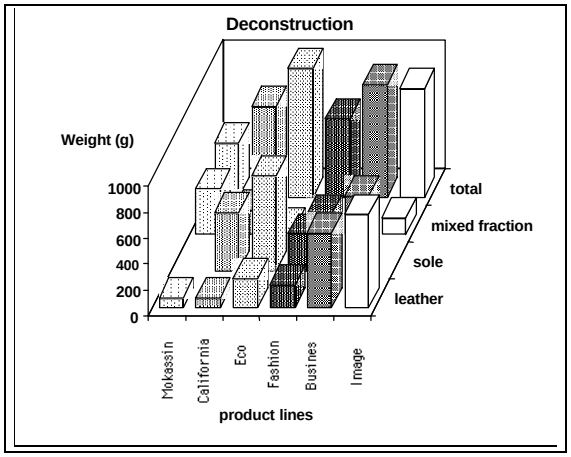

Fig. 9 shows one of the economic driving factors, the deconstruction.

Part III

Three proposals to improve the Eco-Performance are worked out. First, a workshop for sensitising and educating the management was proposed. Indications for this proposal came from both the organisational weak points and the human potential (interviews part one) as well as from the validation of environmental data (part two). The second proposal consisted of a pilot project in ecological product development (based on the economic driving factors), while the third proposal focused on supplier evaluation (based on the Eco-Performance in the life cycle).

Discussion

Conclusions can be drawn from the design and methods as well as from the results and experiences with improvements in the Eco-Performance.

Each choice of method has to be clearly reflected in terms of its aim and the system investigated. For this study, a holistic approach to a complex system including environment, technology and society has been chosen. The decision on a method of qualitative social science has been essential for two reasons. First, focused interviews with employees allow a perception of real life more independent from the researcher than by using standardised questionnaires (Hirsch 1993). Secondly, based on the knowledge gained from these findings, the

further development of the method aims at integrating environmental indicators and technology as well as people's preferences.
As described in the methods, the social science investigation requires a different (cycling) design due to the lack of a pre-defined hypothesis. Therefore, the results have to be interpreted by searching and evaluating adequate theories (Lamneck 1988). In contrast to fitting data of a case study in real life to a "grand theory", this means to find theories allowing interpretation of the data.
Semi-quantitative methods like Sustainability Assessment may show some disadvantages against quantitative methods in the accurate measurement of environmental impacts. On the other hand, quantitative impact assessment hardly ever allows the comparison of different technologies or different cultures in micro- and macroeconomics (Grote 1995, Baitsch 1993). Therefore, the required inter-subjective adjustment of data seems to be worth while, considering the action oriented evaluation as superior aim.
By starting the study with the interviews, the social data was not influenced by the experience of what specific environmental data is important to an expert. The division of the investigation in three parts gave additional benefits. Due to personal contacts in part one, which enhanced the credibility of the expert (Baitsch 1993), many people were sensitised and grew interested in environmental issues and more willing to provide environmental data. Part three, the proposals for implementation, could be adjusted to both the economic situation and the human potential. However, it must be stated that the impact of the economic situation in this study was underestimated.
By comparison of the Sustainability Assessment with established quantitative methods (Tobler und Edelmann 1996), we get more information on impacts by using the qualitative method. With both methods the same impacts were found, although with a considerable difference in the time necessary for data collection. Very often quantitative data is missing in small and medium companies, therefore qualitative statements are necessary. Moreover, social parameters like demand for education cannot be documented by quantitative data.
In the Eco-Profiles the parameters of research, environmental strategy and environmental communication appear as key functions for good Eco-Performance by positively influencing the other parameters like life cycle know-how, mix of materials, transport and energy, investments, waste management, waste technologies (recycling, separation, substitution and reduction), health and work safety. The EPs allow comparison of companies of the same branch, but they also reveal branch-specific differences between tanneries, sole production and shoe manufacturing.
A critical point is the balancing of results gained within the company (economic driving factors) against results gained from suppliers. Although the (quantified) environmental load of tanneries is very high compared to those in shoe manufacturing, improvements can not only be required of the supplier. For leadership in Eco-Performance, the internal economic driving factors should be emphasized. The consequences of this discussion on social values appeared in the implementation.
One of the important findings for implementation is that product development and purchase strategies determine impacts in manufacturing along the life cycle. Due to continuous changes in organisation strategies, an inferior level untouched by these changes had to be developed. This reveals that the organisation of a company is a key factor for Eco-Performance or vice versa Eco-Performance can be improved only by a systematical approach.

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