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TOOLS FOR SUSTAINABLE PRODUCT DEVELOPMENT: EXPERIENCE AND REQUIREMENTS FROM THE VEHICLE MANUFACTURING INDUSTRY IN SWEDEN

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ABSTRACT

This paper presents an empirical study on the use of tools for sustainable product development at four vehicle manufacturing companies in Sweden. Different tools that are used in the studied companies are identified and listed while the obstacles and needs for an increased and successful use of those tools are discussed. The study shows that a limited number the identified tools are used in a systematic way, for instance product specific tools that monitor regulation requirements. Impact assessment tools are applied more centrally in the companies with less integration to the design process. However, interest on the available tools has increased and on the ways that such tools can assist and influence design decisions in a more efficient way.

INTRODUCTION

Incorporating environmental aspects into product development is suggested as the most efficient way to reduce the impact of products on the environment. Along with this strategy, methods[1] and tools have been developed aiming to support companies and product designers in particular, during decision making processes. Previous studies showed that a great number of tools are available while the purpose and objectives of those tools may vary significantly (Baumann, Boons, & Bragd, 2002; Birch, Hon, & Short, 2012; Byggeth & Hochschorner, 2006; Poulikidou, 2012). To simply name a few, tools offer possibilities: to provide design recommendations and guidelines, to evaluate the environmental performance of the product, to identify environmental hotspots, to compare design alternatives and more.

Research on the available tools is expanding while the number of publications on new tools is increasing. On the other hand empirical evidence on the use and diffusion of those tools among product design groups remains limited; an observation stated by Baumann et al.

[1] The terms “method” or “tool” are used interchangeably in this text and can be defined as any type of systematized aid to incorporate environmental aspects in the product development or design process

(2002). Since then, a few studies can be found that investigate and discuss the utilization of tools in industries, for instance (Lindahl, 2005).

The study presented in this paper is part of a project that looks on the integration of environmental aspects during product development processes. This paper presents part of the results concerning the tools that are used in the studied companies to support sustainable product development. The purpose of this paper is to map and show the extent that such tools are used but also to increase understanding on the needs and requirements from a user's perspective. More specifically this paper: lists the most commonly used tools and discuss the purpose of their use, identifies and discuss obstacles and difficulties that are affecting the use of tools and presents needs that were expressed by the studied companies.

To this end the overall aim of this study is to add empirical knowledge on the adoption and diffusion of tools that could assist the development of tools based on the user's perspective. Moreover, improvements for more efficient use of the tools currently used within the studied companies can be suggested.

METHODS

Data for this study was collected through semi structured interviews with employees at four different vehicle manufacturing companies in Sweden. The studied companies represented different modes of transportation which assisted in providing an overview of the sector. Interviewees included: environmental specialists and managers, environmental consultants as well as vehicle designers and product managers. All respondents were related to the product development process but in different ways and at different stages. The process of performing the interviews was based on the stepwise method described by Kvale (2009). The responses of the interviews were then classified in different themes and clusters that were derived according to the research questions of this work (Miles & Huberman, 1994).

RESULTS

Tools were utilized for various reasons in the studied companies and at different stages of product development. The main purpose was to evaluate the environmental performance of the products, collect information and generate ideas about future products, to monitor compliance with regulation and more. Table 1 presents the tools that are common for at least three of the four studied companies and for which more information was obtained during the interview process. Based on the discussion with the environmental experts and design engineers opportunities and limitations of the tools are also presented. It should be mentioned that tools diffusion varied and different maturity levels were identified since some of the companies have greater experience in the use and development of tools than others.

A number of different needs and recommendations were also expressed by the respondents mainly by those involved in tools selection and development. Such recommendations include: more integrated tools that would be able to combine environmental with other design aspects in a reliable way and also tools which information can be easily accessible. A need for standardized and harmonized tools within company was also expressed. A general comment concerned increased education and information exchange about the different tools but also about the outcome of different assessments performed within the companies.

Table 1.List of tools used in the studied companies. Obstacles and limitations based on users' perception.

Tool	*Type*	*User*	*Benefits for the users*	*Obstacles*
Environmental benchmarking	Comparative indicators	Environmental specialists/product developers	• Comparisons with competitors and other industries • Provide incentives for improvements	*No specific comments*
Environmental Design Guidelines	Generic recommendations/ guidance	Designed for vehicle engineer designers	• Helpful recommendations to engineers • Provide basic input on aspects to consider	• Too vague for the designers • No hands on requirements- • Improvements and implementation is more difficult to monitor and may also lead to undesired results if not assessed properly • Generally too many checklists and guidelines exists
Recycling calculation and guidelines	Recycling guidelines	Vehicle engineers and environmental specialists	• Labelling of all materials - easier for recycling processes • Ensure compliance of the product	• Detailed information is needed in order to be able to calculate the exact percentage
Substance and chemical control lists	List of materials, substances and chemicals that are restricted or prohibited to use	Environmental specialists were responsible for customizing the tool, while multiple users were identified for collecting and reporting information. Designers, suppliers and environmental specialists should verify compliance	• Ensure compliance of the product with different requirements (legal, costumer, company) • Easy way to refer and check	• Time consuming to collect information • Resistance and delays from suppliers due to long supply chains and confidentiality issues • Delays lead to not efficient use- late in the process where changes are not possible
Material database systems	Databases with information about the exact composition of all vehicle components	Environmental specialists were responsible for customizing the tool, while multiple users were identified for collecting and reporting information. Supplier should also provide data.	• Ensure compliance of the product with different requirements (legal, costumer, company) • May provide input to other tools e.g. LCA • Labelling of all materials - easier for recycling processes	• Time consuming to collect information • Resistance and delays from suppliers due to long supply chains and confidentiality issues • Delays lead to not efficient use- late in the process where changes are not possible
Life cycle assessment (detailed and simplified versions)	Environmental impact assessment tools	Environmental experts / consultants /researchers	• Robust tool • Suitable to identify key areas of improvements • Provides a complete picture of the product • Supports guidance and decisions • Possibilities to use the results as baseline for future products	• Time consuming- Big and inefficient tool • Need for detailed information to obtain reliable results • Not suitable to implement early in product development • Not easy to connect results with quantitative environmental requirements • Low competence in some of the companies to apply the tool- need for LCA experts • Similar results if performed at a product level • Not so suitable to address local effects and hazardous substances • SLCA are not so reliable for this product

DISCUSSION

Interest of the studied companies on the available tools has increased and different tools have been tried or developed through the years. Today, only a few of those tools are applied in a systematic way and managed to be integrated into product development processes. These are product and sector specific tools that capture regulation requirements e.g. substance and material control lists. Environmental design guidelines seem to be less helpful due their quite generic nature. The use of impact assessment tools e.g. LCA varies significantly among the companies. LCAs are performed by an expert, which limits the interaction with product development groups. Quantitative tools are generally preferred as well as tools that provide outcome which can be connected to specific design requirements. Product developers expressed a need for education and for tools that can be integrated into engineering design tools. The majority of limitations concerned information collection, due to the fact that many stakeholders are involved, but also lack of competence, commitment and motivation. These limitations are more related to internal processes within the company and not so much to the tools per se. Even in companies with a long experience in the use and development of tools such obstacles have not been overcome yet.

CONCLUSIONS

The experience of four vehicle manufacturing companies when it comes to tools for sustainable product development was presented in this paper. Use and interest on such tools has increased compared to previous research although sufficient integration of tools within product development units is not achieved. The obstacles for a more systematic use of tools were related both to the tools but also the users. It can be concluded that a combination of tools can be of more help if designed properly to meet the needs of the user and suit the design processes and existing tools in place. Moreover users need to also adapt to the requirements of the tools and modify the processes and information management that would increase their efficient use.

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