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INTEGRATING ENVIRONMENTAL ASPECTS IN PRODUCTS

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Abstract

This paper present the result from two different interview studies made in Sweden. One study had focus on companies developing consumer products and focus of the other study was product developing companies. The companies in the study were from small to large size.

Many different aspects need to be considered when a product is developed. Most of them are connected directly to the function of the product such as speed, weight, height etc. Historically the main focus has been the products functionality, other aspects such as environmental, design, and ergonomic have been considered as less important.

The study show that size of the company affects how the companies work with environmental issues. The larger companies were more active regarding the work more with environmental issue. They have the possibility to have in-house knowledge or to contract external support to study their products.

1 Introduction

In this paper the integration of environmental aspects into the product development process is discussed. Environmental demands can also be hard to specify like other demands, especially functional demands. In order to make companies consider the environmental issue as important as other product requirements external pressures are required [Vercalsteren, Jansen, 2001]. Many different tools are available and this makes it difficult for companies to choose which the best for their product is. The same tool can be differently used in different companies. Further on Skoglund and Svensson [2002] have stated that too many tools can act limiting on the creativity, and companies cannot miss a tool they have not tested or used. To get the best result out from a tool it should be one that fits together with the product and the development process of the company. Even successful Ecodesign pilot projects are no guarantee that the approach will be integrated on a regular basis in the normal business [Brezet *et al.*, 2001].

This paper also presents the result after a number of interviews from companies in Sweden. The aim with the interviews was to find out how they work with integrating environmental demands in the product.

The engineer's task includes selecting appropriate material, designing products for recycling, reuse, remanufacture and waste, whilst management's challenge is to ensure that the different players like raw material supplier, systems of delivery and recyclers, employees and consumers understand and achieve the environment goals [Baumann *et al*, 2002].

Many authors have described eco-design projects in different types of publications [see Lennox and Ehrenfeld, 1997; Poole *et al,* 1999; Simons, *et al,* 2000; etc.]. These have been special projects or follow-up on previous projects with a clear focus on eco-design. This is a study of companies that don't develop products with a specific environmental profile, and the focus is on how they handle the environmental issue in the process of product development.

2 Aim and objectives

Aim is to see how environmental aspects are integrated into the product. Do different companies have different strategies how to deal with environmental issues for their products. To be able to achieve sustainable development the product development plays a crucial role.

3 Method

The starting point was a literature review in order to study earlier findings related to product development and sustainability. Seven companies with product development and developing consumer products were investigated through semi-structured interviews. The survey was based on the Qualitative Research Interview method described by Kvale (1997). All the interviews were conducted as phone interviews in order to be able to cover a larger geographical area. The people interviewed have been design-, product-, or development managers. All companies develop product which are not frequent bought. None of the products is the kind of product the customer buys every year.
During the interviews and literature review the issue about DfE was connected to questions like sustainable development, product development, design process, and product innovation.

4 Theoretical framework

4.1 Product development

Product development (PD) is an interdisciplinary activity with several different actors such as market, design, and production. The product development process can be divided into different steps see figure 1.

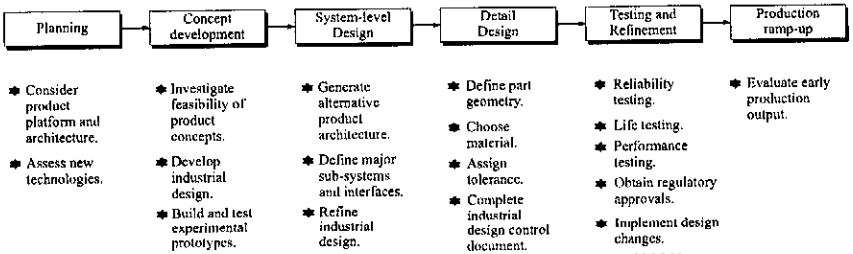

Figure 1. Product developing process by Ulrich, Eppinger [2000].

It is important to remember that: "*Most design problems have a multitude of satisfactory solutions and no clear best solution*". This means that the designer has an opportunity to choose both central concepts and less important issues throughout the product development, see figure 2. The degree to which the environmental aspect is considered throughout the product development process therefore depends on the individual engineer/designer.

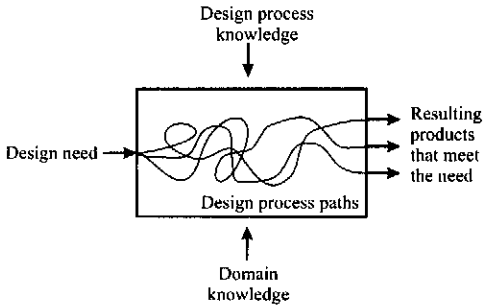

Figure 2. The many results of the design process, [Ullman, 2002].

Designing is a combination of many different factors, for example creativity, technical knowledge, mathematical knowledge, and team dynamics. According to Paul and Beitz, [1997], there are three different elements in designing:

1. The psychological aspect; designing is a creative activity that also calls for a sound base in mathematics, physics, chemistry, mechanics, thermodynamics, hydrodynamics, electrical engineering, production engineering, materials technology and design theory, together with practical knowledge and experience in specialist fields.
2. The systematic aspect; optimization of given objectives within constraints. Because both objectives and constrains will change with time, also the result of the optimization will change with time.
3. The organizational aspect; a close collaboration with specialists from many different fields is required. Information from purchasers, production, manufacturing and customers must be coordinated.

There is not one true solution but a multitude of different solutions to every design task, and designers have to consider the environmental issue throughout the entire process in order to make environmentally sound products.

4.2 Design for Environment

Design for Environment is a strategic question which is more and more important for the management of the company [Ryding, 1995]. Furthermore the aim is "*to decrease the total environmental impact of a product's life-cycle and at the same time satisfy society's need of products and services*" [Ryding, 1995]

A starting point for designing products with lower environmental burden can be to study if the product is active or passive. Active products are products that need energy during the usage phase of the life cycle e.g. refrigerators, trains, boats. They may also need another product system to be able to deliver their function. Life cycle assessments show that for active products up to 99 % of the burden can be found in the usage phase related to energy

consumption for active products [Hanssen, 1998; Kaebernick and Soriano, 2000; Landfield and Karra, 2000]. A passive product does not need any energy to perform its function. Examples of passive products can be a table, fence, bridge etc. Since passive products do not use any energy during the usage phase the possibility is great to find the major burdens during the manufacturing or end of life treatment. All the products in this study were active.

5 Results and discussion

In general Swedish consumers seem to have lost some interest for environmental questions. The interviewed companies did not feel the same pressure regarding the environmental issue as they did some years ago. This is similar to the results in other studies of Swedish companies [Åkermark, 2003]. The way to increase market share is to lower the price rather than to improve the environmental performance of the products. This means that there is little room for an improved environmental design unless other benefits can be gained. However, in many cases an environmental advantage can in fact be linked to economic benefits, such as lower energy consumption and material savings during production. As Vickers points out the environmental issues and key individuals wishing to influence the organisation to behave in a socially responsible manner are constantly under threat by the more pressing concerns of business survival and profitability in the short term [Vickers, 2000].

Some of the interviewed companies had environmental specialists in order to support the environmental work. There is a differences depending on the size of the company and how the environmental issue is handled. The larger companies were more active regarding the work with environmental issue. They have the possibility to have in-house knowledge or to contract external support to study their products. These findings are similar to Åkermarks study, where the designers interviewed in large companies were aware of how their products affected the environment in different ways. In contrast, designers in the small companies had generally not considered the environmental issue from a product perspective, and there was little awareness of the impact of the products in their different life phases. Environmental design generally implied avoiding hazardous substances rather than minimising the environmental impact of the product [Åkermark, 2000].

All interviewed companies except one had integrated the environmental issues into the product development process. Within the companies there were milestones, tollgates, or checkpoints when the environmental consideration had to be addressed. The company that had not integrated the environmental issue was dominant on the market for their product category. Their product is more innovative than their competitors and considered the best design. They had previously made changes on their product but had to reverse it back to the original design due to critics from customers.

It is important to know how the product will affect the environment in order to know what could be done to improve it. In large companies designers usually consider these questions during the design phase and are aware of the environmental impact of the products. When designing, many different aspects have to be regarded: function, economy, production, safety, and so on. When the environmental issue is integrated, product development becomes even more complex. According to Johansson [1999], integration of the environmental issue leads to an increased number of design options and an increased uncertainty regarding the optimal design decisions. A majority of the interviewed companies they think that environmental considerations are difficult to integrate in the product. Partly due to conflict within the company between design department and the market department, or design department the customers focus on motor effect instead of performance. For example, due to this conflict the

material changes requested by the design department could not be made since the market department disapproved. Material selection is an important step in product development. To find the best material for a required function could be rather time-consuming. It is not possible for designers to be up-to-date on all different materials, so they have to rely on suppliers and purchasing departments. Since there is a demand for timesaving in product development, companies usually have an internal materials list. Designers select materials from these lists, which are more or less updated but not complete. As a result mainly of lack of information, the optimal material is often not selected [Wansel *et al.*, 1998]. It is obviously favourable for companies to comply with current legislation, and there are different control functions within the companies to make sure that this is done. Personal commitment is not very often mentioned as a driving force, but in the case studies this was regarded as very important as an *internal* driving force.

One question was to judge the importance of environmental issues for the company. In a scale of one to five were one is low and five is high. The companies interviewed have an average score of four. The interviewees in the companies' states that their customers consider the environmental issue equal important as the companies. One company have higher demands than the customers demand and on other company say that it varies for market to market, for example, the Californian market have rigorous legislation on usage of fossil fuel. In the companies function and costs are prioritised but also other issues are considered such as environment, design, and ergonomically issues. Generally, in the companies the environmental aspects are not considered as important as design and ergonomically aspects, and are therefore rated lower.

Today the most common environmental method in Sweden is life cycle assessments LCA; with the development of the method and the higher data accuracy from improved software, the method is relatively easy to use. Still the usage of tools for assessing environmental performance is low in the interviewed companies. One of the interviewed company had developed a variation of LCA of their own. In some of the companies students had done LCA, as final examine work, in order to evaluate the products from an environmental aspect and/or for bench marketing. Otherwise they do not use any specific tools, some people did not know if some tool was in use. Stevels states that LCA was promoted as the driver and validation instrument for EcoDesign activities [Stevels, 2001]. The study does not show any correlation between the use of LCA and overall environmental work within the companies. LCA is an important validation in order to improve environmental performance. Design tools are only one way to integrate knowledge resources into the product development process [Lenox and Ehrenfeld, 1997].

6 Conclusion

Research show that the most important driver for implementing sustainable design is legislation [King *et al*, 2004] together with customer demands [Tingström, 2003]. The companies in the study support earlier research in these findings. A number of different driving forces for Ecodesign in companies have been described by van Berkel *et al.*, [1997] and Handfield *et al.*, [2001]. The companies did not considered environmental improvement to be a factor in order to increase market shares. Internal driving forces such as management commitment and employee involvement are important. There is a willingness to support public pressure and to appear as a "green" company.

According to Handfield, *et al.* [2001] management must set up environmental targets and goals and these shall be formulated in the same way as other targets in the technical

specification. Another way of reducing the gap between theory and practice when it comes to implementing environmental concerns is to put a cost on creating a bad environment. Ritzén [2000] has introduced a number of measures to be able to integrate environmental issues into the development process. According to these, management must set the direction of the work, these along with that the procedures might need to change and create individual commitment, developing knowledge and skills, and apply the support tools needed. The mere existence of a structure or a model to follow does not automatically result in sustainable products [Poole, *et al*, 1999].

According to researchers such as Dahlström, [1999], and Ritzén and Lindahl, [2001] it can be fruitful for companies to have co-operation with a DfE-expert when choosing a tool for their product development process. Otherwise the experience of designing for environment can be costly for the company. Unsuccessful use of an ecodesign tool can create considerable distrust of the method used and of environmental issues in general. Also education and training of staff is important to get the mindset and the experiences that the designers need to feel comfortable in designing for the environment and to give examples of good design solutions [Ehrenfeld and Lenox, 1997; Karlsson, 1997; Ritzén, 2000]

At last the decreased interest for environmental issues was obvious when companies were contacted. One third of the companies contacted were interested in joining the project and doing an interview. There was a small commitment for the companies the time spent for each interview was less that one hour and still most companies regarded this as to time consuming. This clearly shows a low interest for environmental aspects within the companies.

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