

THE RELATION OF ECO-EFFECTIVENESS AND ECO-EFFICIENCY - AN IMPORTANT GOAL IN DESIGN FOR ENVIRONMENT

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Abstract

This paper attempts to describe important features of environmental product development (EPD), and relate it to systematic product development and design for X. The contribution is thoughts about challenges within environmental product development, especially in regard to education, and ideas of how to meet these challenges.

1 Introduction

A widespread recognition of environmental aspects as important within product development is seen. Because of this increasing importance of environmental aspects, ecodesign is now included in product development education. An experience from teaching environmental product development is that design students see this as a new approach to product development, and not as one of many aspects within the project. In their project assignment they thus lose weight on other important aspects and activities they would take into account within any other project. Both in industry and among students it is also recognised an emphasis on short term activities, and a require of capacity to solve the short term problems within an eco-effective long term strategy. In the following the measures eco-efficiency and eco-effectiveness are discussed, and environmental product development is seen in connection with systematic product development and design for X, with emphasis on thoughts about future challenges in ecodesign-education.

2 Eco-effectiveness and Eco-efficiency

The measure effectiveness in relation to product development processes may be seen as "doing right things", and the measure efficiency as "doing things right" [1]. These measures may be used to describe environmental performance as well. In environmental product development it is found appropriate to distinguish between the two levels of improved environmental performances, eco-effectiveness and eco-efficiency [2]:

- (i) Eco-effectiveness is improving the total impact on environment when the consumers need or demand is satisfied by alternative fulfilment of the function in question. One way of fulfilling a function is said to be more *eco-effective* than by fulfilling it in a different way, if it gives a larger contribution to sustainability of the eco-system in question than the second way of fulfilling the function.
- (ii) Eco-efficiency is the improved environmental performance of a product through the selection of low-impact material, reduction of material usage, reduced energy consumption, reduced waste and pollution pr functional unit of a product during its life cycle. One unit of a given product system is said to be more *eco-efficient* than one unit of a competing system performing the same function, when the environmental burden of producing, using and ending the life of the first product is less than for the second product.

Consequently eco-effectiveness may be seen as doing the right things, and also as a long term planning question, whilst eco-efficiency may be seen as doing the things right, or a short term performance. It is necessary to address these long term and short term issues simultaneously.

3 Environmental product development in connection with systematic product development

A methodology for systematic product development structures the process in different phases, and constitutes a framework for integrating methods to procure focus on different aspects. The environment dimension is one of many aspects in systematic product development. In [3] the following nine product dimensions are proposed:

1. *Functionality dimension* - related to the technical solution; function, performance, reliability, surroundings, standards etc.
2. *Market dimension* - related to overall customer needs and market orientation
3. *Production dimension* - related to ease of production.
4. *Aesthetic design dimension* - related to the entirety of the product, its "look" and what the product express and signal.
5. *Use dimension* - related to ease of use in all use situations of the product.
6. *Safety dimension* - related to obtain a safe product which only present risk reduced to an acceptable level related to product use.
7. *Environment dimension* - related to protection of the environment.
8. *Added value dimension* - related to documents, services, image etc. following the product.
9. *Product life dimension* - related to dispositional thinking and life cycle considerations which implies requirements to the product, and characteristics needed in the total product life. The product life dimension may be divided into subdimensions like a transportation dimension, a maintenance dimension, a packaging dimension etc.

This list has one dimension specifically concerning the environment, to make it feasible to give particular weight to environmental issues. But also other dimensions might have effect on the environment. The market dimension is mostly taken care of by the marketing and sales functions. Traditionally communication with customers also mainly go through these channels. The intent is to sell as many products as possible. These functions are probably the least "green" business functions today [4]. Within the production dimension on the other hand, focus on environmental issues have found broad treatment through e.g. cleaner production and strategies like "reduction of material usage".

A systematic product development process also need focus on strategic- and long term product planning activities. Research has shown that a general problem regarding product development in companies often is a lack of long term planning [e.g. in 3]. This approach to systematic product development [3] therefore suggest the following four main features of a long term process:

- The product's life and the marketplace
- Renewed knowledge of state of the art
- Long term planning
- New Product development project

These features are in accordance with the cycle model; analysis, diagnosis, advises and correction of the design proposal, a fundamental model for design for X -activities, proposed by Meerkamm [5], and might be appropriate emphasising eco-effectiveness as well. It is anticipated that long term planning is lacking for environmental performance as well. Many companies have now prepared environmental reports, but most goals has to do with the eco-efficiency of their products- their short term action on the area. Statements as "Eco-efficiency- the business way forward" and "Eco-efficiency - the business norm for the 21st

century " is seen (keyword eco-efficiency in www). Within the company Philips they have defined an EcoVision Program. This program defines 5 focal areas; weight (reduction), hazardous substances (reduction), recycling (increase), energy consumption (reduction) and packaging (reduction) [6]. Here this main focus on eco-efficiency is clearly seen. At present, most EPD has focused on eco(re)design, the adaptation of existing products to incorporate environmental considerations, and there has been relatively little eco-innovation [4]. Also at the international Conference on Engineering Design, ICED 1999 both in the opening session, the relevant presentations and in the closing session which emphasised future challenges, a focus on eco-efficiency was observed [7]. Each product ought to be better from an environmental point of view, but it still is an objective to produce more products. This rather conservative approach to future challenges in engineering design is in contrast to the opinion of the designer of the year 1999, William McDonough: "Global warming, toxic waste, poverty and hunger can all be designed out of existence. Never, perhaps, has the role of the designer been conceived so broadly and with such urgency..." [8]. Innovation often involves changing processes within a company. The same is for eco-effective, long term solutions which may involve radical changes within companies as important goals for sustainable consumption is; No, Less, Alternative, Sufficient...

How can we approach these problems in design-education and thus contribute to enhanced attention on eco-effectiveness - the long-term challenge - within the industry as well?

4 Challenges in teaching environmental product development

Our first experiences from teaching eco-design in Norway are described in [2]. In our teaching we have used the methodology eco-design- a promising approach to sustainable production and consumption [9] as a backbone, but with more emphasis on eco-effective future solutions [10]. The methodology is close to a general product development process, but it is still seen as a specific eco-design methodology by the students. In design education it has further shown that it is difficult also for students to see and take into account the relation between eco-efficiency and eco-effectiveness and to solve the short term problems within an eco-effective long term strategy.

As pointed out earlier, the environmental dimension is one of many aspects in systematic product development. To make it easy to take eco-design into account, it is important not to teach eco-design as a new methodology, but as an aspect which may get specific attention in a systematic product development process. Such a process also has short term and long term objectives. Eco-effectiveness is the long term goal in environmental product development, and eco-efficiency is the short term goal.

At the department of product design engineering also elements related to marketing and innovation goes into the curriculum. It is a challenge to harmonise these topics and eco-design within an integrated product development process in such a way that the students also get the proficiency to propose sustainable solutions, and to contribute to responsible marketing.

Within environmental product development the students firstly need to conceive an understanding of the environment, and environmental issues. They should also be presented to connections between design-solutions and environmental effects - to get understanding of cause and effect. To teach eco-design as an aspect within a systematic product development methodology, not as a new methodology, but with focus on methods specifically suited for eco-design is a challenge.

5 Conclusions

The relation of eco-effectiveness and eco-efficiency is an important goal in design for environment, as the relation between long term strategy and short term activities are important in every product development project. In product development the importance of integration between market, product and production is well known, but may still be improved. This is an important challenge for environmental product development as well. Co-operation with, and involvement of marketing in environmental product development is needed. The marketing also has a great response for customer education. "Without doubt, consumer information, awareness and expectations will significantly increase. Many of the consumers in 2020, some of which have not yet been born will benefit from an education-system where increasing importance is given to sustainable issues" [11]. Responsible marketing is thus expected to be a future challenge. The innovative solutions which take us from eco-efficient to eco-effective solutions is also needed. On this way the incremental innovations which take us this way in small steps over a period of time might play an important role. -But then we need clearly defined future goals for sustainable solutions, which is the real challenge!

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