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Methodology and tools of ecodesign

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Cleaner production

ABSTRACT

Purpose: The paper presents a possibility of ecological aspects considering in materials and materials technological processes designing. The main objective of ecodesign concept is environmental influences reducing. The article presents also main tools of ecodesign.
Design/methodology/approach: To sustainable development principles realization it is necessary environmental aspects to engineering design introducing. It is possible only in case of methodology and tools of ecodesign using.
Findings: In the article Checklist (CL), Material Input Per Service Unit (MIPS), Life Cycle Assessment (LCA), etc. as a main tools of ecodesign presented. The basic phases of ecodesign methodology also presented.
Research limitations/implications: Ecodesign makes possible product or service designing and its impacts on the environment minimization. It has influence on every stage of a life cycle of the products: raw material extraction, production, packaging, distribution, use, recovery, recycling, etc.
Practical implications: Taking into account environmental aspects in design, the minimization of the total production costs through the production waste quantity and energy consumption reduction, added materials reduction obtained.
Originality/value: The paper presents ecodesign as a new approach to products design. We can define environmental results of all design activities (e.g. products, materials, technological processes) already on the design stage.
Keywords: Industrial application of cleaner production methods; Ecodesign; Ecodesign methodology; Ecodesign tools

1. Introduction

Increasing requirements of environment protection caused that already on stage of materials and technological processes design devote its special attention [1,2]. This initial phase of life cycle of the product also plays the decisive part in the quality assurance of its functioning in the more far stages of existence (production, using and disposal) in reference to relationship with the environment.

Ecodesign is a new approach to products design. It depends on identifying environmental aspects connected with the product and includes these aspects to design process already on the early stage of the product development. Ecodesign also defines as design for environment (DfE) and design according to the sustainable development principles. Following qualifications we can find in foreign literature: environmental design, ecological design, sustainable product design, green design.

Ecodesign introduces additional dimension to traditional design. Still important part play such aspects: function, safety, ergonomic, endurance, quality and costs. The additional criterion is project estimation from attention on its environment influence.

The consciousness relating ecodesign joins with creativity and innovations. It favours also creating the positive company image, visible on the market [3].

We can often say that environmental strategies are too expensive for enterprises, but in many cases ecodesign makes easy economizing. For example materials, energy and waste production minimizing give direct advantages for manufacturer.

Apart from economizing achievement ecodesign gives the possibility of products obtainment which enlarge the user safety, they are unfailing and better quality.

Ecodesign improvement option only stands a chance, if it is supported by stimuli other than the expected environmental benefit alone. Those ecodesign improvement options were most successful that were supported by several strong internal and external stimuli and not blocked by any no-go barriers (fig.1).

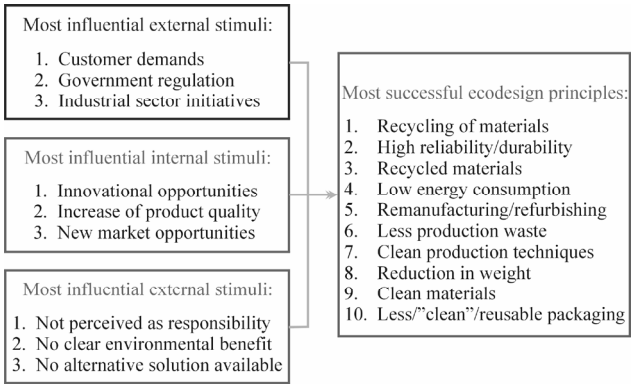

Fig. 1. The most influential stimuli and barriers [4]

2. Concept of ecodesign

Ecodesign concept developed by the World Business Council for Sustainable Development (WBCSD) at the Rio summit is the culmination of a holistic, conscious and proactive approach. Ecodesign makes possible product or service designing and its impacts on the environment minimization. It has influence on every stage of a life cycle of the products: raw material extraction, production, packaging, distribution, use, recovery, recycling, etc. [5].

Ecodesign is a concept that integrates multifaceted aspects of design and environmental considerations. The main objective of design for environment is to create sustainable solutions that satisfy human needs and desires. In professional literature authors [6] have defined ecodesign as:

"Sustainable solutions are products, services, hybrids or system changes that minimize negative and maximize positive sustainability impacts - economic, environmental, social and ethical - throughout and beyond the life-cycle of existing products or solutions, while fulfilling acceptable societal demands/needs".

The main arguments for ecodesign are [7]:

- products and technological processes improving [8],
- costs reducing through verification and modification of the products on early conceptional stages,
- follow the customers needs changing,
- creating new needs and the customers requirements,
- material-consuming and energy-consuming decreasing of products in the whole cycles of theirs existence,
- reducing the weight of products and their packagings,
- reducing productive and exploational costs.

In guide of ecodesign we can find many guidelines as follows [7,9]:

- do not design products, but life cycles

We should design environmentally sound product life cycles. Think about all material inputs and energy use of a product during its whole life cycle (from conception phase to final disposal).

- use a minimum of material

We should take care about rational resources and materials using. We can often reduce the amount of material by critically looking at dimensions, required strength and production techniques.
It can even be beneficial to use materials that have a high environmental load per kilogram, if we can save weight. This is particularly true in transport, where less weight means less fuel consumption.

- energy consumption - often underestimated

We should design considering energy consumption on every stage of life cycle of the product.

- increase product life time

We should take care that the product was useful for a long time.

- use recycled materials [10]

Do not only make your product recyclable, but use recycled materials as much as possible. Reducing of new resources use caused minimizing of waste amount.

3. Methodology of ecodesign

Design process is different for various companies and products. In practice industries joint different approaches and tools to ecodesign and development their products.

In smaller organizations the product development can even lead one person, who works more intuitively than formally. The design process in large enterprises can be formalised, with settled points and the crucial supervisory stages of the management.

The aim of environmental aspects to design including and the product development is solutions searching that preventing negative environment influences formation.

In all stages of design process, the estimation of results in relation to environmental tasks, specifications and products reference follows - the continuous improvement [11,12].

Methodology of ecodesign consists of six main stages (fig. 2).

4. Tools of ecodesign

Ecodesigner can take into consideration many tools about different complexity. We can favour [13,14,15,16]: Checklist (CL), Material Input Per Service Unit (MIPS) and Life Cycle Assessment (LCA).

4.1. Checklist

Checklist is used to analysis chosen areas during ecodesign as: emission into the atmosphere, energy consumption, etc. in relation to particular life cycle stages. Next takes place their validity estimation with quality estimation system using (e.g. five - points scale, compatibility scale). This tool doesn't number data perating. It gives answer for question: where is the main environmental problem.

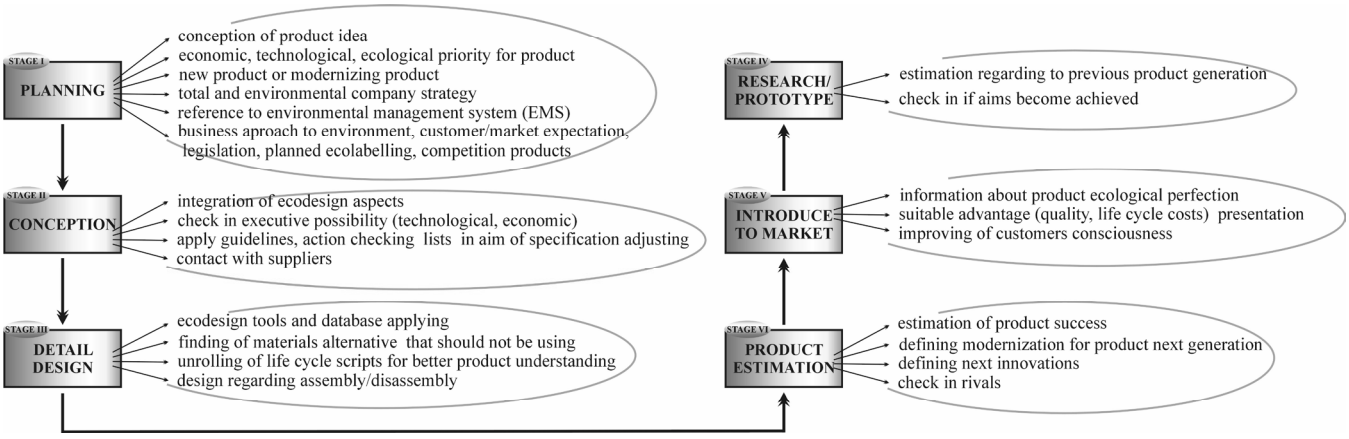

Fig. 2. Schema of ecodesign methodology [12]

Table 1.
Checklist for ecodesign advanced estimation in company [7]

	Criteria	Full compatibility	Partial compatibility	Initiated repair program	Low compatibility	0 compatibility
	Estimation scale	4	3	2	1	0
1	Harmful materials and substances used minimizing	4				
2	All materials used minimizing			2		
3	Energy consumption in production process minimizing			2		
4	Energy consumption in using stage minimizing					0
5	Packaging mass minimizing				1	
6	Recycle ability after using				1	
7	Disassembly easiness after using				1	
8	Monitoring and waste production management	4				
9	Suppliers estimation regarding to their environmental activity					0
10	Environmental benefits by consumer gaining					0
Partial result		8	0	4	3	0
Total (max. 40 points)				15		

Checklist can be elaborated in own range and it doesn't require professional knowledge. In table 1 CL by Centre for Sustainable Design elaborated which based on 4 points scale presented [7]. The results in ZBIA system (Zero, Basic, Intermediate, Advanced) are interpreted. They give an answer regarding to advanced level in analyzed company.

4.2. Material input per service unit

Material Input Per Service Unit (MIPS) means resources input per service unit. It is the indicator based on ecological rucksack conception respective materials, products services by resources-consuming prism. The aim of MIPS indicator is product project elaborated which characterized lowest resources-consuming in whole cycle of its existing. Additional help for this indicator is MIT (Material Intensity) indicator. It is resources-consuming per material unit indicator which shows ecological rucksack respective materials, electric energy and transport. MIT indicators are counted for many materials published by Wuppertal Institute for Climate, Environment and Energy [7]. By MIT and MIPS indicators we can quickly product project estimated and direction of its modification proposed.

4.3. Life cycle assessment

Environmental Life Cycle Assessment is a quantity technique which treats to whole life cycle (from extraction of raw materials, processing, manufacturing, transportation, distribution, use, maintenance, reuse, to recycling and disposal) [17].

It is the tool about wider using range and more complex than MIPS and CL. In case of LCA the analysis includes all kind of environmental aspects. Using Life Cycle Assessment we can identify and estimate environmental influences during life cycles of analysed products.

The methodology of LCA usually consists of four main phases [17]:

1. Goal Definition and Scoping.
2. Inventory Analysis.
3. Impact Assessment.
4. Interpretation.

Correctly realized LCA methodology makes possible resources and energy savings, toxic substances reduction, quantity and harmfulness waste reduction.

An important aspect of LCA is the product End-of-Life (EOL). The product EOL must be dealt with according to jurisdictional requirements and this is becoming increasingly important.

5. Conclusions

Nowadays, a growing number of companies recognise their responsibility to green their products, services and processes.

The impact of a product upon the environment is determined at the design phase, hence the importance of Eco-Design and its tools (CL, MIPS, LCA).

In order to future benefit of ecodesign, the holistic framework for Industrial Design was proposed (fig. 3). It is an effect of design brief for Industrial Design focused ecodesign tools. This framework is a combination of all the elements which need to be embodied in tools. The combination of all the different elements of the framework provides its unique focus, specifically aimed at supporting the activity of designing and the culture of Industrial Design. The framework recognises that Industrial Design is a unique and complex discipline with a distinctive approach to problem solving, learning styles and working practices [14].

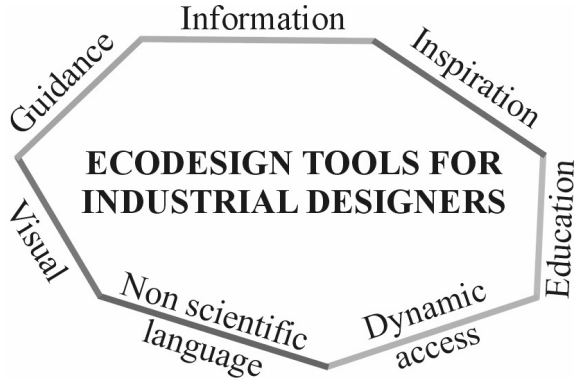

Fig. 3. A holistic framework for Industrial Design focused ecodesign tools [14]

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