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THE ROLE OF PLM IN ECOLOGIC DESIGN OF ELECTRONIC DEVICES

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Abstract: *For many durable goods, including electronics, there are a variety of other design considerations related to total product life cycle. Considering the life cycle of products, the decision makers have to obtain the greatest economic and environmental benefits and identify the specific ecologic potential for each phase of electronic product life cycle. The article focuses on serious environmental and human health impact of electronic devices production.*

Keywords: *product life cycle , ecological, environmental impact*

1. INTRODUCTION

Over the past ten years, more and more discrete manufacturers have deployed Product Lifecycle Management (PLM) solutions to optimize product development and enhance bottom-line performance. Life cycle thinking is the most effective way to cover the environmental impacts of products as a whole. Product design has an important role here as issues related to energy efficiency, material selection and recyclability are already decided upon at the beginning of the life cycle.
Life Cycle Management (LCM) is a unique framework of concepts, techniques, and procedures with the goal of creating sustainable development.
Rather than focusing specifically on environmental, social or economic impacts and/or benefits, LCM combines a variety of tools and approaches to look at all of these factors, how they are interconnected and how to best address these issues throughout the product or material's life cycle.
How these factors are weighted and balanced will depend on what is important to the organization responsible for the management and what is deemed the most important issues throughout the product's or material's life cycle. Environmental issues will continue to increase in importance. In the long run, only responsible companies and brands will succeed.
Information and Communication Technology and mobile technology can also be used to combat climate change. For instance we could replace the possibility of loading music from the Web instead of buying physical CDs, which are produced, packed, stored and transported.
Electronics and electrical industry has grown rapidly in recent years on condition that it was necessary to revisit the rules on ecological issues - waste, hazardous substances or energy

efficiency. It becomes increasingly clear that any Watt in addition to minimum necessary energy products will contribute to realization of a negative impact over environment.
All these issues must necessarily be taken in account when we design new products and more specifically, to project products. An important role plays, in this regard, Directives and their implementing regulations issued by European Commission which are mandatory for our country, as a member of the European Union. The profile standards have an important role in practical application of the European Union Directives and Regulations. Product life cycle management must be considered from the first stage - the choice of materials- until to waste management, under condition of products functions in the best regimes in terms of energy consumer, so throughout their duration, to provide the conditions to achieve high quality products at a lower cost price and having in mind the need to protect the environment.

2. INDUSTRIAL DEVELOPMENT AND ENVIRONMENTAL IMPACT

As it is known, the profit is the main strategic objective of industrial development in market economy conditions. The profit does not exclude, on the contrary, stimulates the achievement of superior quality at acceptable cost prices within competition market.
Limitation of resources, raw materials and energy and the need to protect the environment

3. ENVIRONMENTAL IMPACT DURING THE LIFE CYCLE

Considering the products lifecycle, the decision makers could obtain the greatest economic and environmental benefits and identify the specific potential for each phase of product lifecycle. [4]
During the entire lifecycle, the electronic products are in continuous interaction with the environment, undetaking from the environment materials resources and energy necessary for products manufacturing or discharge its into the environment.
have recently imposed new strategic objectives such as:
- Saving material resources;
- Energy savings;
- Pollution prevention;
- Avoid waste production.
A basic role in promoting these new strategic goals belongs to the design and development activities. Standardization is specifying the specific requirements and appropriate verification methods for these strategy. Up to date, environmental requirements were related especially to the way in wich environment is affecting the products functioning. In order to not harm the environment, the situation was changed, and we added new conditions imposed on the products.
This explains the creation of the new Technical Committee TC 111 within the International Electrotechnical Commission called „Environmental Standardization electrical and electronic products and systems "(having "Romanian mirror": The Technical Committee for National Standards No. 19) whose international standards are including requirements for environmental impact of electrotechnical and electronic products. The objective for the economy energy is reflected first, by a more rational use of electricity consuming products, and secondly by the construction of new energy sources „cleaner" in terms of environmental pollution.
The linkage between the product standards and environmental impact during the entire lifecycle of products can be seen in Figure 1

The main stages of electrical and electronic products lifecycle are:
- Purchase materials;
- Product implementation;
- Packaging and distribution;
- Installation, operation, maintenance and development;
- Reusing products, recycling and materials or energy recovery;
- Final procedures.
These stages and their impact on the environment can be seen in Figure 2.

4. ECOLOGICAL DESIGN OBJECTIVES

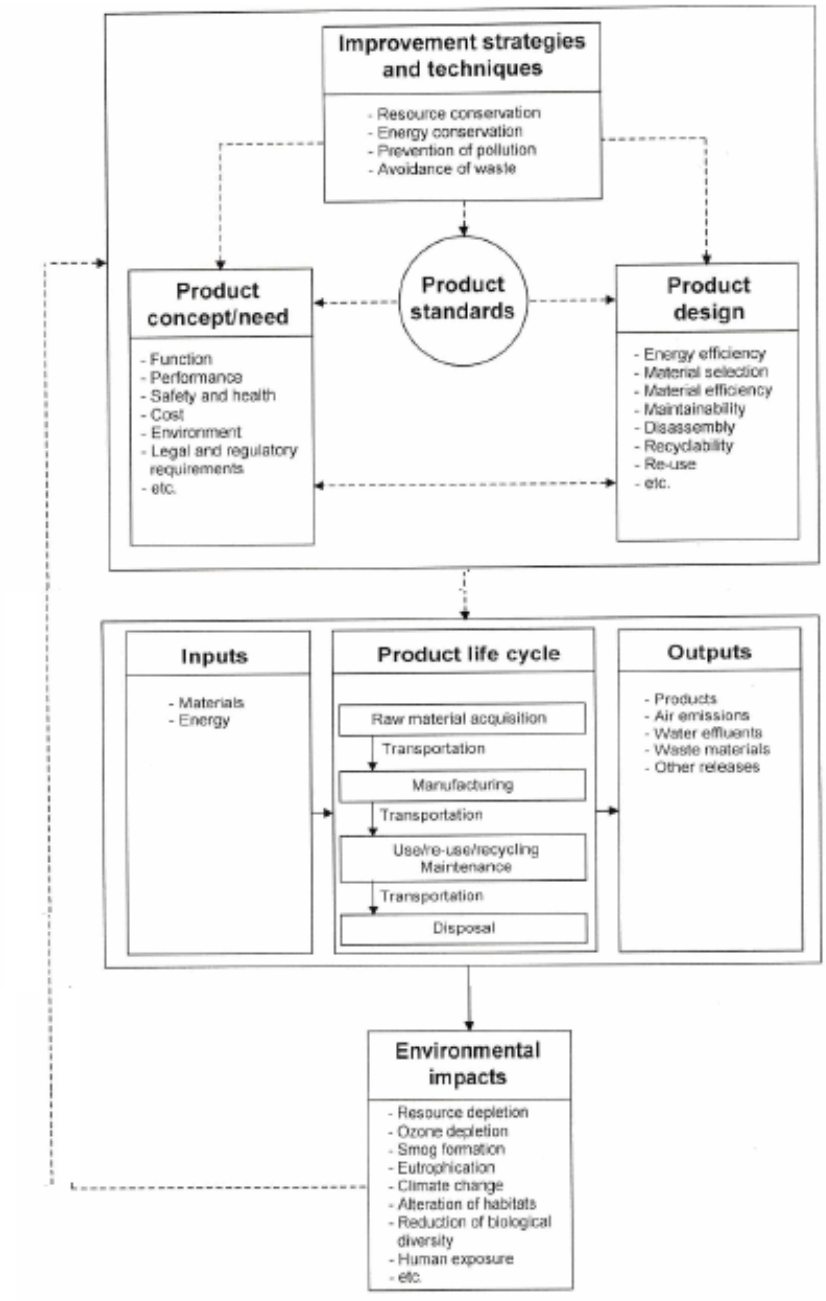

Figure 1. The product standards requirements and environmental impacts during the entire lifecycle of products.

Beyond being just a trend, the ecological design term denotes a mode of seeing

conception and manufacturing activities of a product in relation to its impact on the environment.

It was found, by documenting, that the ecological design has had an extensive development leading to the establishment of a large number of sophisticated ecological models and methodologies, assessment techniques, rules and guidelines design.

Ecological (environmental) issues are difficult to resolve by the fact that:

- environmental degradation progresses slowly, in a very long time period;
- environmental implications events and their effects are developing in large numbers and are evolving hardly over time;
- environmental policies must consider the business and market mechanisms, which hampers finding optimal solutions.

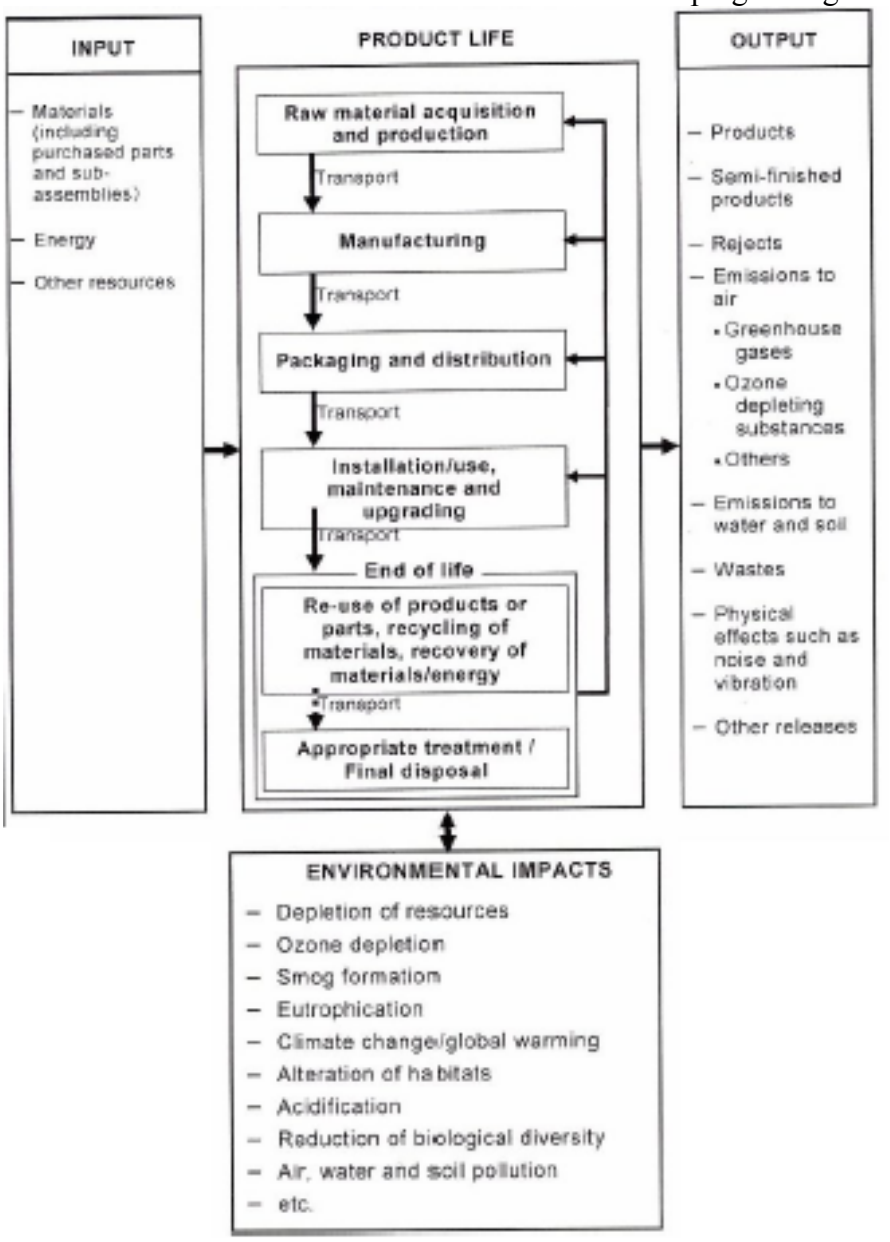

Figure 2. The main stages of the products lifecycle. Inputs, outputs and electronic products impacts on the environment

Taking in consideration that the current ecological instruments have a cvasigeneral character covering products or processes groups, the important issue of users (planners, designers, managers) is to identify the

appropriate instrument for the specific problem which is solved. For a proper optimal design, it is necessary to analyze the product design and compare with other materials, shapes and finishes.
The main activities, that contribute to the ecologic design of electronics products at various stages of development (product strategy, product profile, determining the requirements, product conception) and design (design fundamentals, design targets, detailed design, prototype testing) finished with the release manufacturing, are shown in Figure 3.

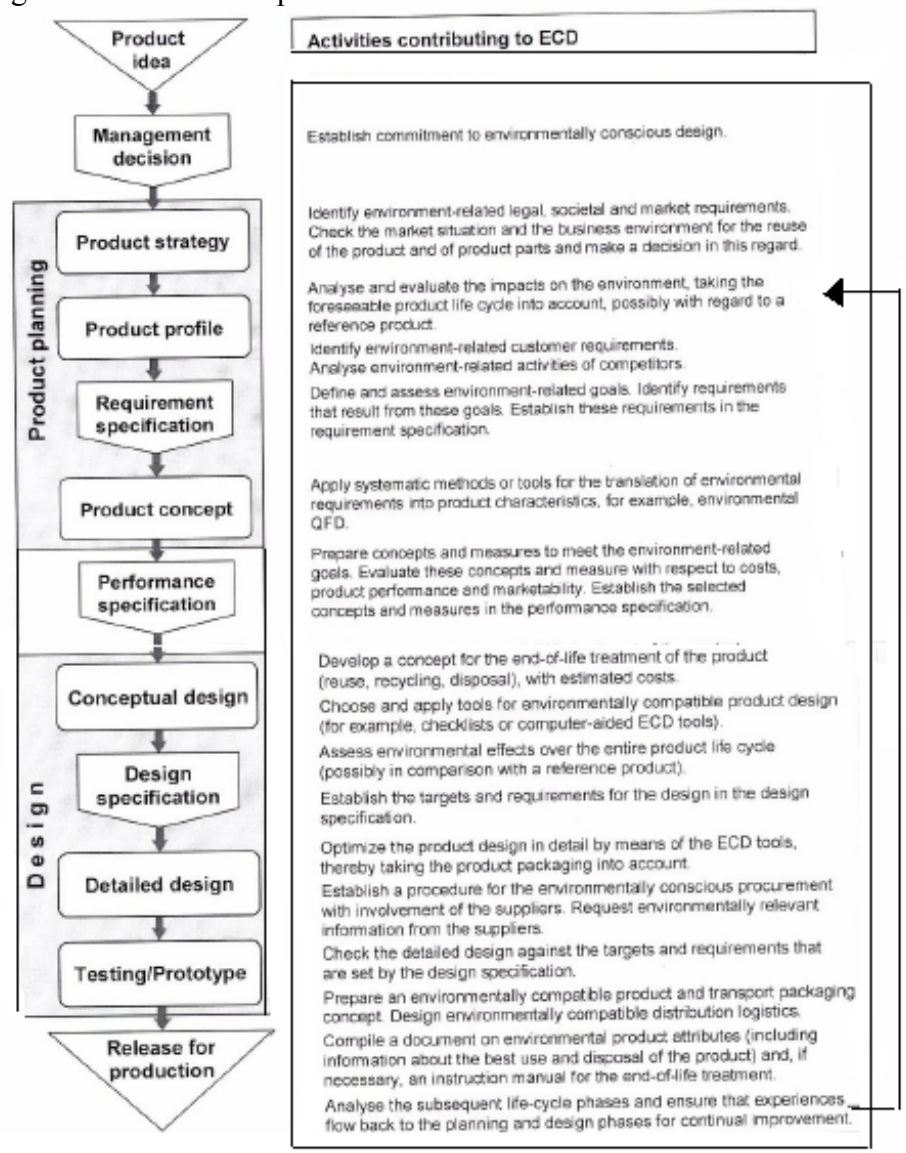

Figure 3. QFD-Quality Function Deployment. Integration of environmental aspects in the development and design of electronic products

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Based on documentation and case studies were established design rules, to mitigate environmental damages. These rules can be structured in different directions: corrections (reuse, reduction, recycling, disposal, replacement, redesign, rethink), consumption (weight, hazardous substances mass, energy, packaging weight), the lifecycle (design, processing, packaging, distribution, use, disposal), chemical-biological (contaminant, the solar effect, cyclical movement, safety, efficiency).
Seven directions were highlighted with the following meanings:
1. New concept development: dematerialization, widening use of the product areas, integration of functions, functional optimization of the product.
2. Selecting materials with low impact: purity, regeneration, low power processing, recyclability.
3. Reduction of used materials: weight reducing, volume reduction,
4. Manufacturing technologies optimization: alternative production techniques, reduced number of production processes, low energy consumption, waste reduction, technological materials (supplies) reduction.
5. Optimization of distribution system: reusable packages, efficient transportation, logistics efficiency;
6. Reducing environmental impact in use: low energy consume, renewable energy sources, small quantity of supplies, ecological supplies without waste and auxiliary energy consumption.
7. Initial lifecycle optimization , reliability, durability, easy maintenance and modular structure.

5. ENERGY EFFICIENCY

Energy efficiency improvement is the main objective of ecological design. Primarily, ecological design should take into account the operating consume modes of electrical energy devices.

6. LIFECYCLE OF GREEN ELECTRONIC PRODUCTS

When we buy new electronic products, we focus on what the newest technology offers us and try not to think about what it took to make that product. But if we scratch beneath the surface, we find that there are serious environmental and human health impacts. There are few other products for which the environmental impacts of mining, industrial refining, production, use and disposal are so extensive. These have had devastating impacts on electronics manufacturing and recycling workers, communities surrounding industrial facilities and areas around the world that have

become the dumping ground for toxic e-waste. We can present you a possible model of electronic products life cycle (figure 4).
Nokia strives to reduce the possible harmful environmental impact of its products,services and operations over the entire product life cycle.

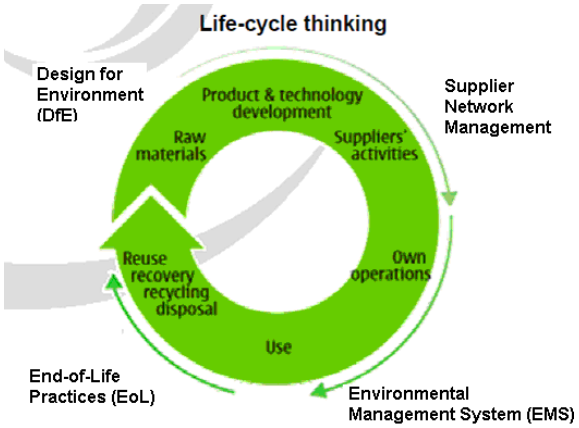

Figure 4. A possible model of electronic products life cycle

3. CONCLUSIONS

The product design must be adapted to environmental issues, seeking (in addition to the classic objective of low-cost and high performance) quantifiable eco-efficiency through reduced negative effects on the environment. Design involvement in the ecological projection has an important economic and educational impact over future generations.
To achieve competitive products, which are including ecological aspect, the designer will consider the necessary material and energy consumption throughout the product lifecycle.
From this point of view, the designer objectives will be: product miniaturization, information and data concentration, digitization, portability, functions integration (value added), energy saving equipment, production processes improvement through intelligent control and automation systems, cleaner production, high functionality with low money.
Materials consumption, energy and other resources used in making a product (Figure 2) can be reduced by optimal management of parameters: the product weight and volume, the recycled materials use, the energy consumption over the life cycle, the use of hazardous substances, quantity and nature of consumables needed for proper operation and maintenance, incorporation of used components.
The choice of materials used in eco-design will take into account the possible technologies to be used for their processing.
Healthy ecological technologies protect the environment, are less polluting, use resources in a sustainable manner, recycle a greater proportion of waste and sub-products they generate and convey the waste in a manner more acceptable to the environment than the technologies which them replace.

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