PRODUCT DEVELOPMENT WITHIN THE SUSTENABLE DEVELOPMENT CONTEXT

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ABSTRACT

The economical power of the European countries will depend on their capacity of satisfying the market necessities and producing and offering products and services that combine the efficiency with the environment requirements. Products creation and development represents a key factor of the enterprise activity, tightly connected with the three pillars of the lasting development, respectively the economical competitiveness, social effects and the effects on the environment. The work spotlights the new way of approaching the products development within the context of the bitter confrontation between the idea of profit, generated by the competition, and the extra costs determined by the green product regarded as result of the limitations imposed by the lasting development principles.

KEYWORDS: *product development, lasting development*

1. Introduction

The lasting development designates conceptually the characteristics of an economical system that satisfies the present generation needs without diminishing the chances of the next generation to satisfy their needs. /8/ In order to be successful in a lasting economy, the enterprise would have to act in the following directions:

- Selection of the ecological raw and auxiliary materials and energy sources;
- Utilisation of the materials and energy based on the principles zero losses and zero polluting emissions;
- Diminishing the losses and polluting emissions;
- Integration into the economical system through suppliers and clients;
- Integration in the social-economical system by the access to relevant information regarding the available products and resources;
- Reference of the economical aspects more to values than to profit;
- Integration in the ecological system by the possibility of reprocessing without negative consequences of all discarded substances that get out from the enterprise.

The strategy of products innovation determines the lasting development strategy of the enterprises./2,3/. The lasting development places to the producer the responsibility of products recycling in order to provide a non-polluting environment. The study of the design directions and strategies, as well as the optimization of the multidiscipline design, lead to the costs reducing by diminishing of the product weight, first of all. Parts and components of small dimensions lead to the creation of products with a smaller weight, diminution of the polluting emissions and reduced fuel consumption.

2. Situation at national level

In Romania, the products traditional design holds yet the most important share, without taking into consideration the whole products life cycle, in all the design phases. Not all the design programs had created interfaces of software CAD assisted for analysis, evaluation and synthesis of the ecological implications and effects. Products designing would have to take partially into consideration all systems that have connections with the specificity of the utilization regime. But not all the polluting manufacture processes have been redesigned. The design of the conversion of the waste into useful intermediate products is only at the beginning. Important steps have been made for the integration of the calculation technique into the conception flow: preparation, manufacture, and sale. The development of modelling and simulation of the economical-industrial processes generated by the product development is carried on without the implication of the industrial waste flow behaviour. Regarding the introduction of Lifecycle Management (PLM), only IBM has extended its offers portfolio in Romania by introducing the solution CATIA, a software for the cooperative design of its component parts as well as the solution SMARTEAM, for the management of product data, developed by Dassault Systems./4/

3. Approaches at international level

At international level, considering normally the list of the most important enterprises and corporations, it is had in view to harmonize the points of view of the producer and user regarding the products life cycle. The research of the Fraunhofer Institute identifies the product development as the main paradigm for the next ten years. Three main directions in what concerns the product development have been identified: increase of competitive solutions number, shorting/hurrying the iterative ringlets and self-control organization. From an organisational point of view, a change without precedent is proposed for the organisational structures: passage from a stiffly controlled, hierarchical structure to a self-adjustable and self-governable net structure.

In Germany, by The Digital Auto Project program, the diminishing with 50% of the product development time is proposed. The project is based on three working principles: increase of the simultaneity of the designing charges; elimination of certain designing charges, as the physical prototype; more rapid completion of the remaining project.

In the USA, at the basis of the product development stands the idea that only by the way of choice shortening the designing, building and manufacture processes can be fundamentally changed. Simultaneity designing/study leaded to the reduction of the personnel with 25% and implicitly, to the costs diminution.

In France, the accent is put on the methods that lead to the best solutions of materials for the new products, so that a recycling ratio of 95% could be provided, by choosing plastic materials. At the whole world level, the tendency is to utilize the multidiscipline design optimising, a design technique of the complex systems and of sub-systems exploiting the synergy of mutual interaction of the phenomenon. The methodology offers the possibility of answering the questions: how to decide what to change? What change is amplified when the system is interactive (each of them influences each of them)? All these are possible due to the possibility of achievement of a very big number of iterations in a very short time, many solutions succeeding to be studied at a relatively low cost, by the implication in the evaluation of all the points of view of the relevant performance attributes.

4. Optimization of multidiscipline designing in the products development and conception

The capacity of direct memorization imposes strict limitations in the quantity of information that, as human beings, we are capable to receive, to process and to remind.

More than four decades ago, Miller published his study in which he presented, among his ascertained facts, that a magic number 7 (+/-2) is the maxim number of sensorial inputs that a person can manage without making mistakes. In time, this problem was studied in detail both by psychologists and other research workers in sensorial sciences, but, generally the theory remained available.

A tendency in the evolution of the technical-economical systems was the increase of the creation capacity that leaded to performing improvements. In the same time, the resulting complexity for the interconnected systems increased in an extent that surpasses the mental capacities of the human being to study correctly. /9/ As reached complexity would not be enough the modern communications systems supply to us mountains of information, among which a lot are non-systematic, non-important, redundant or incorrect; all these produce more confusion than clarity.

The products design process is recognised as involving activities which have two categories of effort (fig. 1).

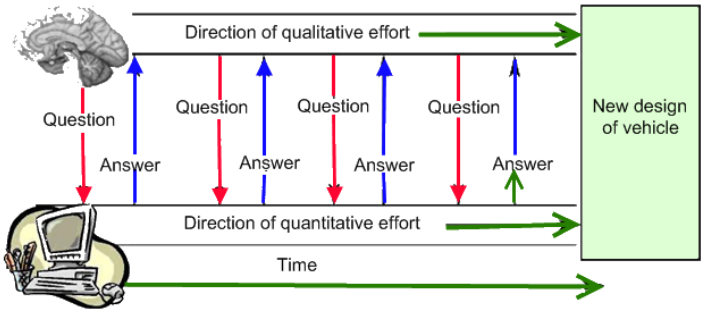

Figure 1 Mixing of qualitative and quantitative efforts in the products designing

A part of the effort is qualitative, dominated by inventive spirit, creativity, intuition and capacity of synthesis. Another part of the effort is represented by the qualitative side, focused on the number of answers received to the questions appeared in the qualitative part. The process advances by the continuous iteration question-answer between the two parts. Even if at the beginning it was believed that the design optimization is destined to replace the designer and his skill, the reality demonstrated that it is not the case. In fact, none of the designing optimization application does specify what has to be optimized and which are the designing variables – quantities and parameters that can be modified with a view to providing an optimum design. The MDO methodology emphasises the realistic approach of the designing in which the role of the human mind is recognized as directing force in the designing process and the mathematics and computers functions as indispensable instruments. This way is consonant with the creative characteristics of the human brain and with the efficiency, discipline and infallible memory of the computer.

MDO involves a coherent and quickly adaptable structure, having the possibility to present to the users a simpler and easier picture as the main designers have also the role of product manager. MDO processes are easy to achieve being interactive, permitting to formulate the designing problems in real time, supplying clear design results. MDO

processes can be adapted to the problem nature and complexity, application compulsions and at the level of the simulation fidelity specified by the product team.

Resources, particularly human ones, have to be entailed into suitable combinations to create new solutions supporting the organization/enterprise progress (see fig. 2).

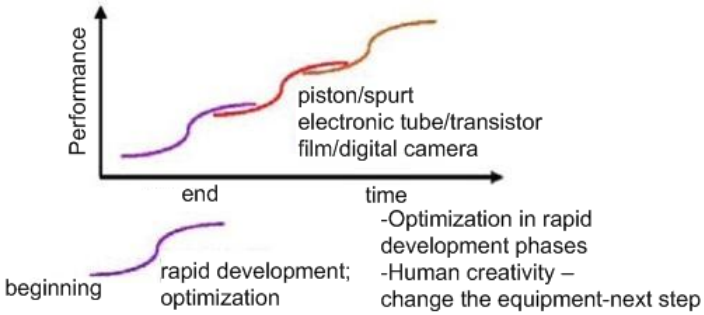

Figure2 Sinusoidal scale of the technical-economical progresses

The sinusoidal curve is sequential, has always a beginning and an end, the progress being seen as a clinch of the respective curves

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Classic designing/lasting design analysis

The classic algorithm of the design process comprises many specific steps shown in the sketch of fig.3.

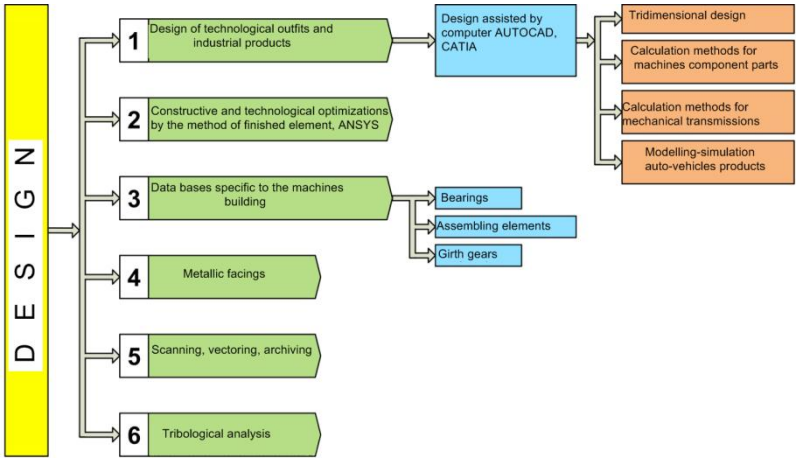

Figure 3 Classic algorithm of the design process

Into the framework of the classical algorithm of the design process, the followings steps are comprised:

- Design assisted by computer (AUTOCAD, CATIA) of the technological outfits and industrial products;
- Constructive and technological optimization (by the utilisation of the finished element, ANSYS);
- Utilization of data bases specific to the machines building;

- Metallic facings: technologies specific to chemical and electrochemical facings;
- Documentation scanning, vectoring and archiving;
- Tribological analysis.

Lasting design of the industrial products involves besides functional, economical and environmental aspects also elements of social and ethical nature. The purpose of the ecological design into the lasting design context is to minimize the impact of product and processes on the environment on whole life cycle, concomitantly with benefit, performances and quality maximizing.

Products lasting design has to achieve the harmonising between the ecological approach and the conditions imposed by the social and ethical implications. The ecological design has in view the minimizing of the negative impact of the products on the environment on whole life cycle and the benefit, performances and quality maximizing. The estimation of the quality of a product from an ecological point of view is made by studying the volume of prejudices on the environment during the whole life cycle.

Eco-design, as integrant part of lasting design (fig.4), has at it basis many components, integrated into the concept Design for X (fig. 5).

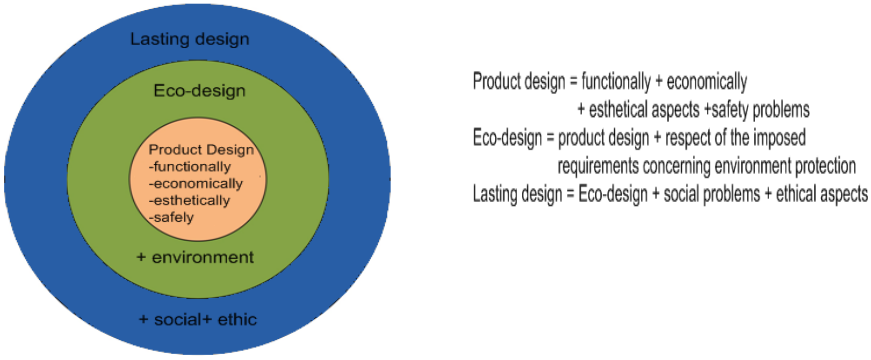

Figure 4 Concept of lasting design

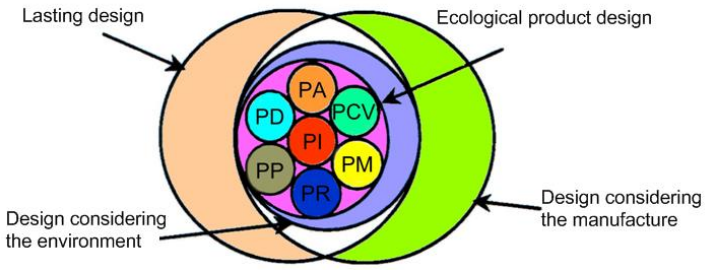

Figure 5 Concept of Eco-design – design for X

PM – design for the environment; PP – design for processing; PA –design for packing;
PD –design for dismantling; PI - design for maintenance; PVC- design of life cycle;
PR – recycling-reutilization design.

The products have to excel in satisfying the clients requirements by providing functional performances, economical profitability, liability and, in the same extend, regarding the impact on the environment. The components of the lasting design process are shown in fig. 6.

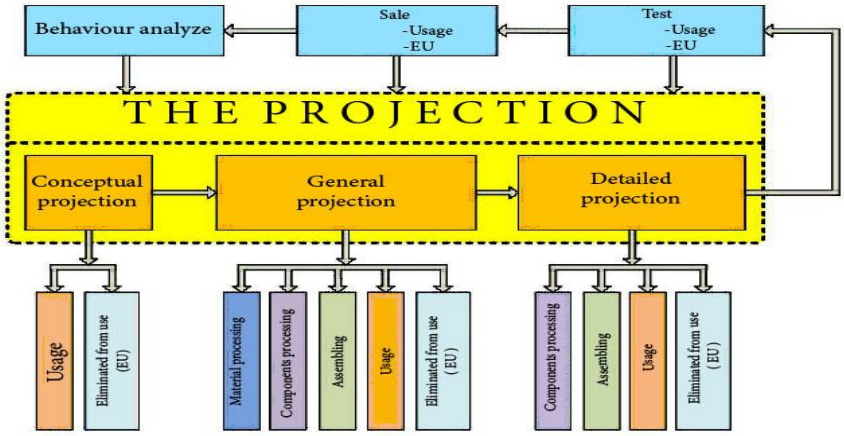

Figure 6 Components of lasting design process

Into the framework of the charges analysis, planning and definition phase the followings are approached: existing and future situation; main and specific objectives; requirements that define the next product properties.

The conceptual design phase supposes the generation of new ideas, concepts, technical solutions and the selection by evaluations of the best solution from the economical and ecological point of view. The general design phase leads to the main solution regarding the constructive structure. The detail design phase supposes to identify the aspects of the product component parts processing and the product technical documentation finalizing.

The actual requirements impose the creation of friendly interfaces, of software packages by integration of ecologic software modules in the packages CAD/CAE/CAM. /1/ Recognition of the necessity of completion of the traditional design methodology by introducing from the product conception phase of the environment requirements imposes the respect of some basic rules:

- Consideration of the entire life cycle in all design steps;
- Implication of the aspects related to the products removal from use following the reutilisation, remanufacturing and recycling feedbacks;
- Creation of interfaces with the instruments CAD/CAE/CAM of analysis, evaluation and synthesis of the ecological implications and effects;
- The design of the products and component parts taking into consideration all systems that are into connection with the products;
- Utilization of software packages having data bases with high level of interactivity of the user;
- Utilization of simple instruments for the current design;
- Utilisation of meta-knowledge in the products design.

5. Aspects regarding the products eco –design

The eco-design represents a proactive approach that permits the anticipation and the respect of the actual and future environment regulations and the transformation of the requirements in opportunities at a minimum cost.

The eco-design puts the accent on the reduction of the products impact on the environment during their whole life cycle by an improved product design. This is achieved by the integration of the environmental aspects into the design phase, by considering the whole product life cycle between the purchasing of the raw materials and the product throw. The "eco" particle means in the same time economy and ecology.

For certain consumers, aware of the environment protection importance, which are aware that the green products are in many cases more efficient than the other products, we can say that the "green" is better sold (fig. 7).

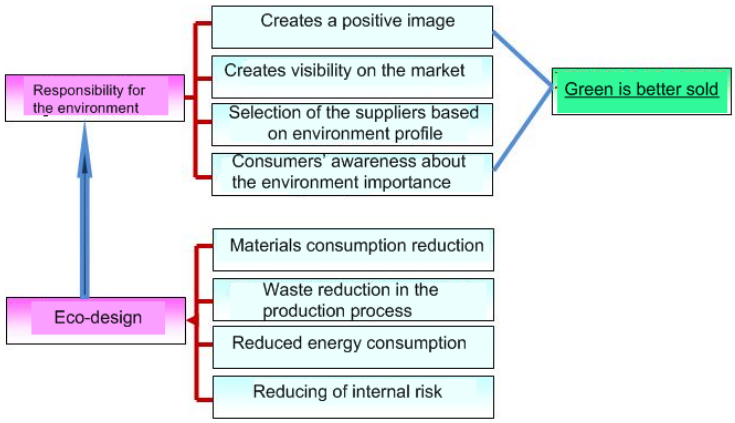

Figure 7 Products responsibility for the environment

Besides a bigger efficiency of the ecologically designed products, these ones present a bigger security level, they are more liable and of a better quality. Generally it is affirmed that the environment strategies are lavish but, in many cases, eco-design leads to economies. With this meaning the materials consumption and waste reduction during the products manufacture process with reduced energy consumption represents direct benefits for the manufacturers, without mentioning the reduction of intern risk and employees motivation. Application of an eco-design strategy means therefore the development of innovation product with high efficiency leading to a pro-active approach, on the way of legal conformity.

The big companies request to the suppliers at least the utilization of some minimum environment management principles. With this meaning the companies ask for details concerning the used materials, going from substances checking lists to complete declarations concerning the materials. Consequently, to be considered a "green" producer is an argument to be chosen as supplier. Furthermore, the suppliers have to comply with the exigencies imposed by the total quality principle, that supposes: personnel periodical attestation; analysis laboratories accreditation; accepted technical level for the installations of treatment of the products out of use; high standards for the de-polluting, storage, collection, recovery, reutilisation and recycling operations.

6. Optimization of the products shape

The industrial products are confronted today with radical changes in the market competitive conditions. In the context of globalization and of reduction of the products development time, the individual client orientation is no more limited and connected to the increase of products advantages complexity, but directed especially on the products quality. Optimization of shape became important in the development of the means that can be applied in the achievement of possible operations in chain (net). /7/

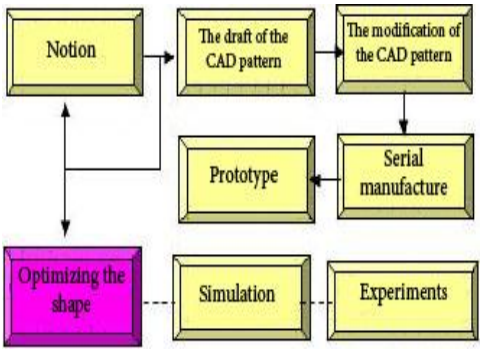

Figure 8 The chain of processes development using the optimization

Conforming to the chain of processes development using the optimization, the design decisions can be made based on many known details. Thus, the first CAD drawing needs a very high qualification as it has decisive impact on the products development and traversing of the procedural road used in the shape optimization (see fig.9).

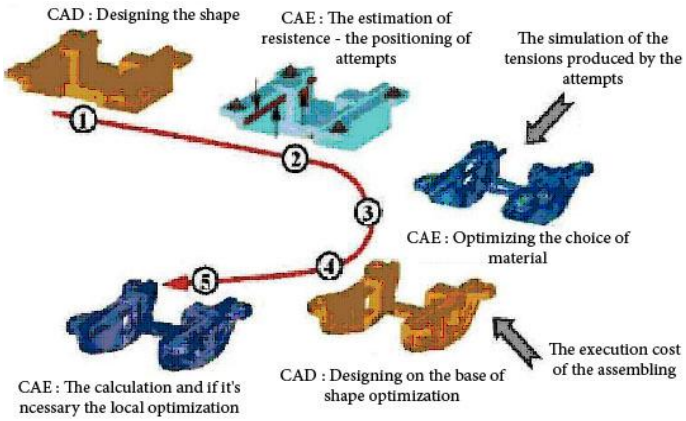

Figure 9 Procedure followed in the shape optimization

The potential ideas and plans in design starting can be used in the conditions of the existence of an adequate luggage of knowledge and experience from the designers' side. In the case of the products shape optimization it is had in view the utilization of a smaller quantity of materials that lead to a weight reduction concomitantly with the manufacture

cost reduction. The result of the shape optimization is based on a given geometry the design having relevance in conditions limitation. A proposal of the design derived from the optimization can be used further in the shape optimization with a view to minimizing the effective stresses concomitantly with products weight minimizing. /10/

The success of the component elements improvement and perfection is completed by the rigidity of the tests and by the assembling in the final product geometry./6/ The optimization topology is en efficient instrument used in the products development. The optimization helps in finding of new solutions and in product quality increase and involves the ascertainment of an efficient method in the design detail having a result on the entire product life cycle by the following effects:

* Reduction of the local stresses by outlines optimization →decrease of the components wear →prolongation of utilization time;
* Decrease of product weight →reduction of materials consumption →reduction of manufacture costs;
* Optimization of the product geometry →incorporation of the components in restricted spaces →weight decrease →fuel consumption decrease in the case of auto vehicles →decrease of the polluting emissions quantity. /5/

7. Conclusions

Lasting development offers a changed perspective on the product as the product development is considered starting by the consideration of environment aspects. Product environment study grants a better understanding of the composition and function of the product component parts, as well as of the relations on the entire flow of supplying with raw materials. An adequate management of this flow represents a premise for a superior quality of the entire product.

The majority of enterprises can act directly or indirectly on the products development improvement involving in the products development and eco-design chain the productive entity, the intermediary who merchandises the product, the participant in defining the conditions of contract and the sub-contractors.

Products lasting design permits to make a difference by respect to the competition offering a new image of the products and permitting the exploration of new original improvement ways. The approach initiated by eco-design represents a source of innovation and distinction from the marketing point of view by outrunning the market's expectations. Eco-design is seen as a new lever of internal motivation by intensifying the activities and works regarding the product.

Improvement of the product development will be achieved by the enlargement of changing possibilities in the initial phases as the costs of defects repair or elimination increase exponentially with each step of the product development cycle.

Yet in the product conception phase it is taken into consideration that the recycling takes place on whole product lifecycle enlarging this way the possibilities of improvement of the study and consistence way of the lifecycle and permitting the re-design of the products in the vision imposed by the lasting development concept.

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