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Environmental Compatibility of Mechanical Engineering Products (MEP-s)

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BIOGRAPHICAL NOTES

prof. Ing. Juraj Muránsky, PhD. Degree in Mechanical Engineering, graduation into professor in Production Engineering at Technical University of Košice, specialisation eco-design in mechanical engineering. During his activities, he co-operated with lot of institutes and universities in Slovakia and abroad. Some of them : TH Otto v. Guericke Magdeburg, TU Manchester, Ministry of Industry SSR, MTA-SZTAKI Budapest, ITK Minsk, FTN Novi Sad, VŠDS Žilina, VUOSO Prague, VUSTE Prague, ZA-5 Vítkovice, VUKOV Prešov, TU Miskolc, VW-FI Braunschweig. At the present time he is an external EU environmental projects solver at CEU Prague. Author of 245 papers in journals, 8 monographes, more than 100 contributions at international conferences, 17 patents concerning different problems in mechanical engineering.

Dr.h.c. prof. Ing. Miroslav Badida, PhD. He is a graduate of Mechanical Faculty of Technical University of Košice. His scientific and research work focuses on the field of environmental engineering. An accent is put on the issue of environmental management systems, ecologization of products and their production and life cycle analysis of products. Lately his attention is paid on research in the field of physical factors of working and living environment.

KEY WORDS

Design and development, eco-design philosophy, requirements representation, software tools, a practical application

ABSTRACT

The basic principle of eco-design is that as the various stages of MEP development proceed, technical choices become increasingly limited and the possibilities of reducing environmental impacts are correspondingly limited. Consequently the environment must be factored in as early on as possible in the process. One of the essential characteristics of eco-design is that by adopting such an approach and adding the tools of eco-design to their conventional design tools, designer´s work can have extremely positive effects on the environment. The results achieved – environmental compatible MEP-s. An example from automotive industry.

INTRODUCTION

The expression „eco-design" refers to the concept of taking environment into account when designing products (goods and services). It implies the addition of the parameter „environment" to the set of conventinal parameters used in design (such as market requirements, cost control, technical feasibility, etc.). In a competitive environment such an approach is of value to various different economic players such as manufacturers, retailers, consumers and purchasers (both public and private) who are keen to or purchase, (assuming that levels of service are identical) more environmentally-friendly products - in this case MEP-s.

Because eco-design is prior to decision-making. it is a preventive approach. And indeed where better than during the design phase to reduce the sources of possible impacts on the environment ? After all, it is design choices which have the greatest influence on the ultimate environmental characteristics of products.

FORMAL EXPRESSION OF DESIGN AND DEVELOPMENT PROCEDURE OF MEP-s

An up-to-date MEP must fulfil the technical, economic, environmental, aesthetic and market requirements. Formal expression of these requirements is carried out by means of a set system. Its graphical representation is in Fig. 1.

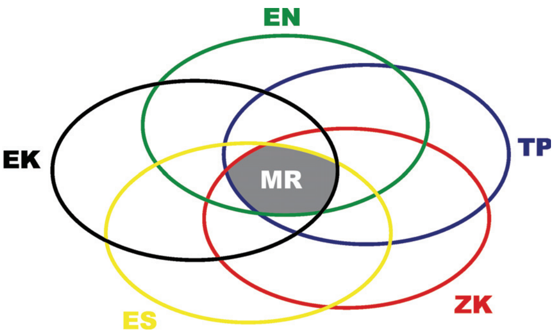

Fig. 1 *Graphical representation of the different requirements on the up-to-date MEP-s by means of the set system. Abbreviations: TP-technical, EK -economic, ES-aesthetic, EN-environmental, ZK-market requirements. MR-area of the possible solutions*

Put simply, with conventional design and development constrain solution had to be found in the MR area, where the four basic sphere overlapped. The addition of the EN sphere has modified the scope of possible solutions which must be chosen from within area where the all spheres overlap. By this way the environment has been integrating into MEP-s design and development.

ECO-DESIGN PHILOSOPHY FOR MEP-S

Reference document on eco-design is the standard XP ISO/TR 14062 (2002) and its derivative for the Slovak conditions – Act NR SR no.665/2007 Z.z. Starting from these standards, a eco-design philosophy for MEP-s has been obtained. Its graphical expression is illustrated in Fig. 2.

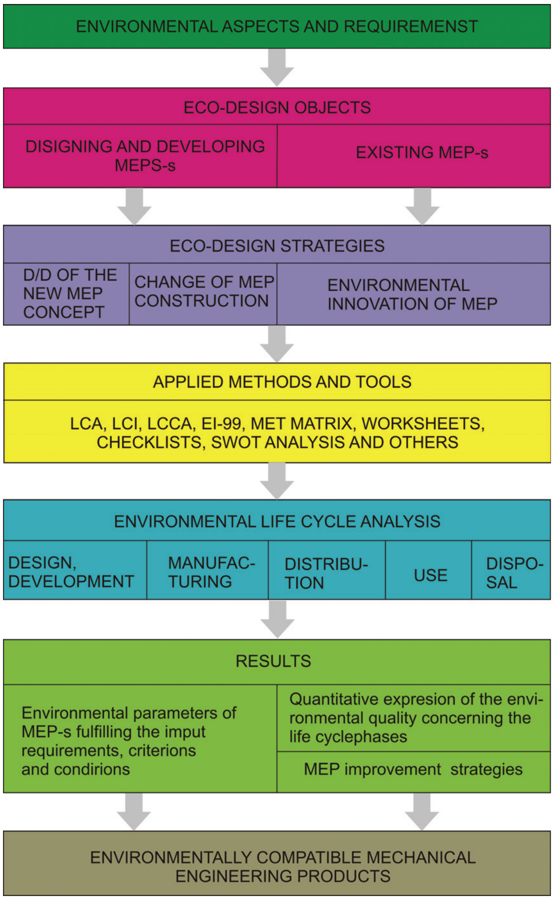

Fig. 2 *Scheme of eco-design philosophy for MEP-s; Abbreviations: LCA-Life Cycle Assessment, LCI-Life Cycle Inventory, LCCA-Life Cycle Cost Analysis, MET- Materials, Energy, Toxicity, SWOT-Strenght, Weak-ness, Opportunities, Threats, D/D-Design and Development*

Environmenttally compatible MEP-s are the final results in this scheme.

CONCEPTUAL PHASE OF ECO-DESIGN - THE MOST IMPORTANT ONE IN MEP-S LIFE CYCLE

Almost all properties of the D/D MEP-s are determined in their conceptual phase. The D/D of an environmentally friendly MEP requires the assess-

ment of its potential environmental impact during the D/D process. Particularly in the early MEP D/D stages the potential for the environmental optimisation is high.
By the way - concept of the Integrated Product and Process Development (IPPD) is illustrated according to its scheme in Fig. 3

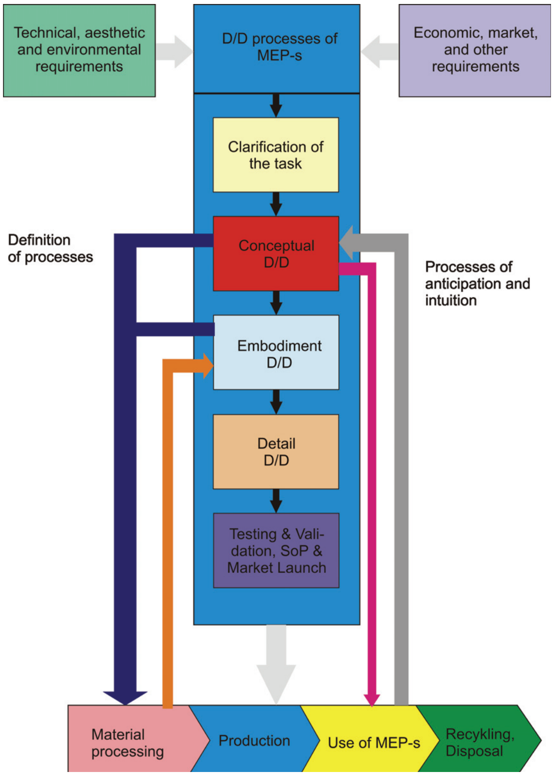

Fig. 3 *Concept of the Integrated Product and Pro cess Development of MEP-s. Abbreviation: SoP - Start of Production.*

Feed-Backs

Once requirement have been defined in the requirements list, the MEP designer and developer has to convert them into concepts. A MEP concept is an aproximate description of systematically generated and assessed principle solutions. In course of the concept D/D process, the solutions are generated by a stepwise concretisation of the MEP-s functions, physical effects and working principles and assessed with regard to the requirements defined in requirements list. In the following the concepts are serving as basis for the embodiment and detailed D/D.

APPLIED METHODS IN THIS PHASE AND MEP-s OPTIMISATION

The most popular methods for the use in the D/D process are checklists, comparative avaluation of MEP concepts and LC-QFD (Life Cycle Quality Function Deployment) method. The main principles of these methods are in detail described in the concerning literature.
Some other possible methods are the Theory of Inventive Problem Solving (TRIZ - Teorija Rešenija Izoberateľskich Zadač), Morphological Matrix, and M-N-P method (Minimal Number of Parts).

ACONCEPT - A SOFTWARE PRODUCT FOR CONCEPTUAL D/D OF MEP-s

Some of procedures and methods described above, have been applied as a fundamental core in the software product CONCEPT. Its structure is illustrated by a flow-chart - Fig .4.

CONCLUSION

Simple, clever, fun. That´s the philosophy behind the vehicle you see in Fig. 5 - the Loremo. Its main technical parameters are in the table 1. Production version of the Loremo won´t be available until 2009 in Germany. And what is the final statement? Environmental compatibility of this MEP in practice.

Fig. 5 *Environmentally compatible vehicle Loremo (Low Resistance Mobile) [3]*

	Loremo LS	**Loremo GT**
Seats	2+2	2+2
Motor	2-cylinder **turbo-diesel**	3-cylinder **turbo-diesel**
Output	15 kW/20 HP	36 kW/50 HP
Maximum speed	160 km/h, resp. 100 **MPH**	220 km/h, resp. 137 **MPH**
0-100 km/h	20 s	9 s
Weight	450 kg	470 kg

Cosumption	US/UK **MPG**	US/UK **MPG**
Tank (Liter)	20, resp. 5,28 gallons	20, resp. 5,28 gallons
Fuel range	1300 km, resp. 808 miles	800 km, resp. 497 miles
drag	Cw = 0,20 Cw.A = 0,22 m^2	Cw = 0,20 Cw.A = 0,22 m^2
Dimensions (1xbxh)	384 cm x 136 cm x 110 cm	384 cm x 136 cm x 110 cm
Price	< 15.000 **Euro**	< 20.000 **Euro**

Tab. 1 *Technical data of the Low Resistance Mobile (LoReMo) [3]*

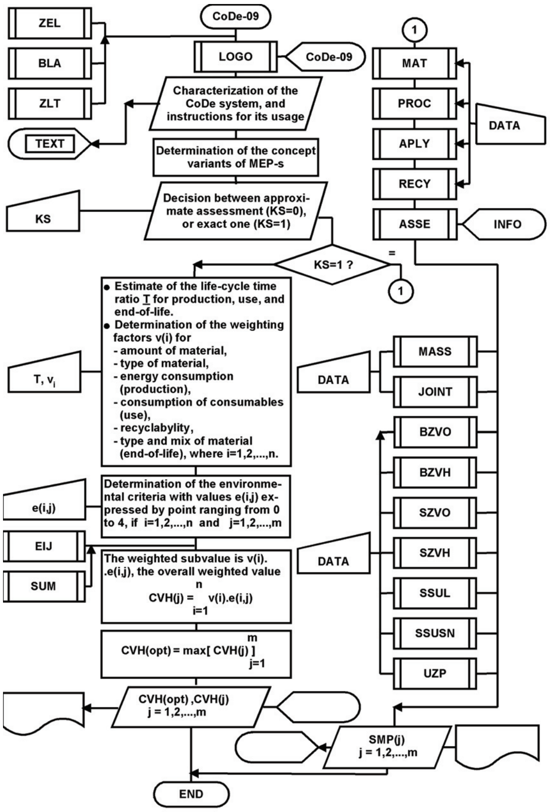

Fig. 4 *Structure of the software product CONCEPT. Abbreviations : LBR-List of Basic Requirements, OLR-Ordered List of Requirements, ELR-Extended List of Requirements, AM-Applied Methods, MI-NUP, EVAL, MORPHO, SYNT, INPUT, TRANS - sub-routines, EcoCAD - softwa- reproduct [4]*

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REFERENCES

[1] Y Abele, E. at al : Environmentally - Friendly Product Development. Springer - Verlag, London, Berlin, Heidelberg , 2005, 319 p.

[2] Eco-Design Discovery Kit. ADEME, Anger, 2001, 80 p.

[3] Available from : http://editorial.autos.msn.com/article.aspx?cp-documentid=57882

[4] Muránsky, J. : Príručka ekodizajnu pre strojárov. SD(VLK), Košice, 2006, 200 str., ISBN 80-8073-532-8

[5] Muránsky, J. : Environmentálna kompatibilita strojárskych výrobkov. SD(VLK), Košice, 2008, 300 str., ISBN 978-80-969887-9-2