Editorial

D. Millet*

Design and Ecodesign Methodology Lab,
SUPMECA – Toulon, Quartier Mayol,
Maison des Technologies, Toulon, 83000, France
E-mail: dominique.millet@supmeca.fr
*Corresponding author

D. Brissaud

INPG, GSCOP Laboratory,
68, rue F. Viallet, Grenoble, 38401, France
E-mail: Daniel.Brissaud@g-scop.inpg.fr

C. McMahon

Department of Mechanical Engineering, University of Bath,
Bath, BA2 7AY, UK
E-mail: enscam@bath.ac.uk

C. Herrmann

Institute of Machine Tools and Production Technology (IWF),
Technical University Braunschweig,
Langer Kamp 19b, D-38106 Braunschweig, Deutschland
E-mail: C.Herrmann@tu-bs.de

A. Aoussat

ENSAM of Paris,
Laboratoire CPI, 151 bd de l'Hopital, 75013 Paris, France
E-mail: ameziane.aoussat@paris.ensam.fr

Biographical notes: Dominique Millet is a Full Professor at Department of Design of Mechanical Systems, SUPMECA, Toulon. He received his PhD in Design Sciences from ENSAM of Paris in 1995 and his 'Habilitation à Diriger des Recherches' from INPG in 2003. His research interests include design and ecodesign methodology. He has published over 100 technical papers in major international journals and conferences.

Daniel Brissaud is a Full Professor at INPG, Grenoble and in the GSCOP Laboratory.

Chris Mac Mahon is a Professor of Engineering Design in the Department of Mechanical Engineering at the University of Bath, which he joined in 2002 from the University of Bristol.

Christoph Herrmann is a member of the Board of the Institute of Machine Tools and Production Technology (IWF) at University of Braunschweig (Deutschland).

Ameziane Aoussat is the Head Manager of the New Products Design Laboratory at ENSAM of Paris since 1999. He is a Full Professor and had published in a lot of various publications concerning engineering design.

Recent times have seen an increase in raw material costs, opposition to incinerators and discharges, stricter environmental legislation, increased urgency to reduce climate change, increased sensitivity to environmental issues from consumers, etc., all of which place a strong demand on environment-friendly product design.

Many research works have been developed worldwide in order to integrate environmental issues into the design process. Resulting from these developments, various tools and methods have emerged, including design for disassembly, design for recycling, selection of materials for green design, quantitative life cycle related methods such as life cycle assessment, qualitative life cycle related methods such as material energy toxicity matrix and material intensity per unit of service (MIPS), environmental quality function deployment (QFD) such as e-QFD and eco-QFD and environmental effects analysis (EEA).

The evolution of product design is very positive and the tools and methods have become more complete and robust. However, the existing tools and methods have their weaknesses: they are product-centred rather than service-centred, multiple life cycles are rarely considered, they are generally oriented towards improvement rather than innovation, sustainability criteria are hardly taken into account and so on.

To overcome these weaknesses, new knowledge, tools, methods, approaches and concepts more focused on service, sustainability and eco-innovation need to be developed. It is the purpose of this special issue to get up-to-date knowledge and the most recent developments in this subject and to spread them within our community.

The special issue ‘From Green Design to Eco-innovation and Sustainable Product Design’ contains six articles covering a wide range of subjects, including sustainable design, eco-innovation, environmental value of customers, life cycle design, environmental assessment method, environmental improvement method and design for disassembly tool.

The first article ‘The limits of current evaluation methods in a context of sustainable design: prudence as a new framework’ has been written by Carmela Cucuzzella. This paper suggests that sustainable design within a perspective of precaution can complement dominant preventive methods of decision-making used for ecodesign. More specifically, the author shows how a precautionary approach can be used with the logic of sufficiency, relying on individual behavioural changes as well as on social innovation, to complement the traditional preventive approaches based on the logic of efficiency for establishing/assessing sustainable solutions. As a consequence, precaution may allow designers to develop new areas of insight and influence for addressing this.

In the second paper entitled ‘An integrated analysis of customer value and environmental burden for environmentally conscious design’, Koji Kimita, Yoshiki Shimomura, Tomohiko Sakao, Tatsunori Hara and Tamio Arai notice that many environmentally conscious products/services are available in the market; however, these products/services are not necessarily acceptable to customers at present. A possible

reason for this is that few ecodesign methodologies and tools have been successfully used to effectively meet customer needs. Eco-products/services must be environment-friendly as well as conform to the customer requirements. The authors propose a method for integrated product analysis from the viewpoints of environmental burden and customer value. The effectiveness of the proposed method is verified through its application to a case study (the redesign of a food processor).

In the third paper, Shinsuke Kondoh, Nozomu Mishima, Keijiro Masui and Mitsutaka Matsumoto develop the idea that significant uncertainties exist (e.g., operating conditions, user preference, post-consumer product collection rate, etc.) in the product life cycle, requiring a design method that is robust and tolerant against these uncertainties. To this end, their paper discusses design strategies for products and life cycles to enhance total performance as a defence measure. A robust design method is proposed for maximising environmental and economic performance for the product life cycle. The effectiveness and feasibility of this method are demonstrated through a simple example of laptop computers.

The next article 'How to identify the most promising areas of environmental improvement at the early stages of the design process?' written by Dominique Millet, Nicolas Tchertchian and Daniel Brissaud, identifies a lack of methodological supports concerning the choice of the best area of environmental improvement in the early stage of the design process. The proposed solution consists of setting up a product model comprising the main design parameters relating to environmental performance. A design of experiments reveals the contribution of each parameter to the global environmental performance (evaluated by the end-score of the EI99 method). The deliverable of this tool is:

1 the evaluation of the rate of environmental improvement for each area of improvement

2 its level of technico-economic feasibility

3 its level of user attractiveness.

With this information, the design team is able to make better choices corresponding to what seems most feasible for the company, most acceptable for the user and best for the environment.

In their article 'Study of an exergy method for environmental evaluation assessment in the early design phase using comparative LCA and exergy approach', Galina Medyna, Harri Nordlund and Eric Coatanéa consider that environmental evaluation analysis made at an early design stage is an important practical problem because existing approaches, such as LCA, require detailed information about the studied product or service. Consequently, to be efficient such a method requires a product or service located in an advanced development phase. An exergy method offers an appropriate solution for an environmental evaluation analysis at an early design stage. The authors propose to validate the concordance of the results provided by the exergy and LCA approach, as LCA is a widely used approach even though its scientific validity has been questioned. The validation of the exergy approach is addressed by comparing results of a case study (two manufacturing methods for a part of a pressure regulator) analysed through both an LCA software and an exergy approach.

The last article ‘A liaison model for disassembly-reassembly product ecodesign’ comes from Christian Mascle and Ke Xing. Their paper focuses on non-destructive disassembly for mechanical products as part of environment-friendly manufacturing. An original approach using a clustering method for assembly and the introduction of a mathematical model, describing the fuzzy liaisons between the components are introduced by the authors. They also facilitate the determination of the problems related to the automation of assembly and disassembly sequences generation. To do so, the modelling of functional liaisons between parts helps to distinguish a simple contact from an attachment and subsets from subassemblies. Liaisons between components are described by matrices of fuzzy half degrees of liaison. The virtual locking liaisons could be extracted automatically from a B-rep model of a mechanical product on CAD and attachment liaisons are deduced from a fuzzy evaluation of their strength and condition changes.