Use of life cycle data in industrial design.
Draft report on the development needs.

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Introduction

The present draft report has been prepared within the auspices of the CODATA, the Working Group on Environmental Life Cycle Inventories. The objective of the working group is to facilitate the electronic exchange of high-quality, easily comparable data on environmental product life cycle inventories (LCI-data) for materials.

This objective is pursued by several activities, one of which is the subject of the present draft report: To assess the need for further development regarding the use of LCI-data in industrial design, the CODATA Working Group investigates the current trends, the requirements of industrial designers, the pitfalls to avoid when applying LCI-data in the design process, as well as the needs and obstacles for integrating LCI-data in electronic tools used in design (CAD), manufacturing (CAM) and product data modelling (PDM). In this investigation and assessment, the co-operation of the UNEP-Working Group on Sustainable Product Development is being sought.

The interfaces between Life Cycle Assessment and Design for Environment

The interfaces between Life Cycle Assessment (LCA) and Design for Environment (Eco-design) are illustrated in figure 1.

The figure illustrates:

a) Industrial designers have stated requirements to LCA methodology to the effect that LCAs should be more socially and future oriented. These requirements are being met by recent improvements in LCA methodology (Weidema 2000). At the same time, the understanding of the uncertainty of LCI data and LCA results is slowly increasing.

b) In the communication of the typical LCA result to the users (in this case: the designers), three different levels of detail can be distinguished (in the dotted box in the middle),

c) The communication problem is at the interfaces of the central box:

   i) in the generalisation necessary on the right side of the box, where it must be ensured that the generalised data are not unnecessarily distorted or oversimplified, so that the generalisations lead to misrepresentations and wrong decisions,

   ii) in the specific application on the left side of the box, where it must be ensured that the information is in a form meeting the immediate requirements of the designers (so that it will actually be used) and so that it is interpreted correctly, e.g. including the necessary causal understanding of uncertainty and context.

The three levels of detail in communication in the dotted box in the middle of figure 1 are:

1. *The level of 'Rules of Thumb'* where no numerical data are communicated, but the essence of the data and results are distilled and translated into 'Design guidelines' or 'Rules of Thumb'.

2. *The level of 'Simplified data'* where LCI data and results are communicated in the form of easily comprehensible indicators, such as 'eco-points'.
3. *The level of 'Simplified methods'* such as the application of matrix-LCA methods and the MECO principle (Wenzel et al. 1997, Hauschild et al. 1999), where key data and qualitative information is used to produce quick, but transparent and reliable results.

All three levels are relevant, but for different applications, or at different stages in the design process.
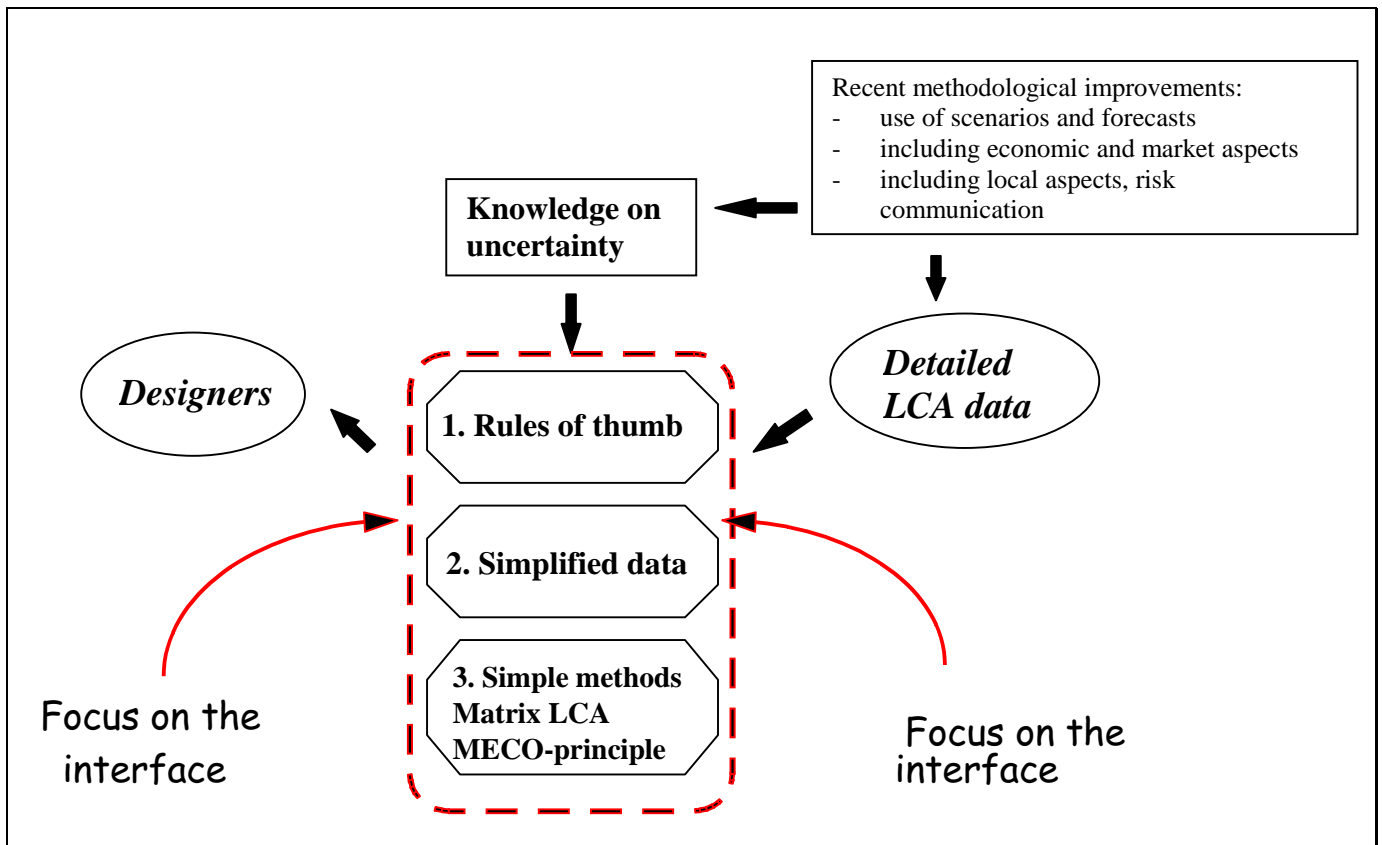

Figure 1. The interface between LCA and Eco-design

Besides the three mentioned levels of communication, a fourth level can be distinguished in which designers and LCA-specialists work together in a teamwork, so that detailed LCI data and results are used directly. In this case, the communication is implicit and may not involve the same problems as for the three other levels. Furthermore, a level 0 may be identified in the form of 'environmental prejudice' which is the information used by the designer in the absence of communication of LCI data and results.

The three levels in figure 1 can be regarded as separate layers of the user interface of the same database, all based on the same detailed data (which would then be level 4). In the design of these interfaces it is important to make use of visual aids (including error bars, and not necessarily using digital values) also for the links between the different layers. Especially, the human tendency to overlook the conditions and uncertainty of the information supplied should be counteracted (e.g. by requiring the conditions to be specified before information is supplied). In many ways, the

communication problems involved are similar to those involved in communicating with consumers by means of environmental declarations on products, making joint research relevant. The CODATA Working Group recommends the initiation of sector-specific projects with a high degree of user involvement in the specifications.

The foundation of all of levels of communication is the existence of adequate detailed LCA data. While this paper focuses on the communication of LCI data, it should be noted that the very existence of these data is not ensured today.

Furthermore, it should be noted that as a group, 'designers' include many different kinds of people and functions (e.g. marketing oriented versus technically oriented), which may have very different degrees of environmental knowledge, different use of LCA tools and data, and thus different requirements to a database interface. In parallel, designers in different industrial sectors may also have very different requirements, and that it will probably not be meaningful to design a sector-independent database interface. However, with more experience based on sector-specific experience, it may later be possible to extract some general lessons.

The CODATA Working Group does not judge it necessary to integrate LCI data in electronic tools used in design (CAD), manufacturing (CAM) and product data modelling (PDM), since the amount of joint data is limited. Nevertheless, future standardisation in other areas than LCI may make such integration more relevant (see the last paragraph of the CODATA document *'First progress report on the harmonisation of exchange formats for LCI-data'*).

Conclusions
Two areas of research and/or development have been identified:
1) The application of knowledge on the causes of uncertainty in LCI data, to guide the creation of meaningful generalisations/simplifications. The issue of uncertainty in LCI data and its causes has been known for a long time as an important research topic, but until now too little work has been carried out in this field.
2) The design of user interfaces and data structures of LCI databases accommodating the needs of designers. See above for further specifications.

These research topics need to be further elaborated and communicated to the relevant researchers and national and international research programme developers.

References

Hauschild M, Wenzel H, Alting L. (1999). Life cycle design – a route to the sustainable industrial culture? CIRP (Collège International pour l'Etude Scientifique des Techniques de Production Mécanique) Annals 48(1).

Weidema B P (2000). LCA developments for promoting sustainability. Presentation for 2nd National Conference on LCA, Melbourne, 2000.02.23-24. (Available at http://www.lca.dk/publ/austr.html)

Wenzel H, Hauschild M, Alting L. (1997). Environmental Assessment of Products. Vol. 1: methodology, tools and case studies in product development. London: Chapman & Hall. ISBN 0412 80800 5.