Editorial: Is LCA Unique?

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Dear Readers,

Recently there has been much discussion about the "tool box" of environmental assessment instruments indicating, very reasonably, the need to use different methods or a suitable mixture of methods for solving different problems. This discussion automatically leads to the question formulated in the title or, the other way round, is LCA just one tool out of the toolbox?

LCA is a science-based, essentially comparative environmental assessment and managing tool for product systems. The approach is "cradle-to-grave", hence the name "Life Cycle Assessment". The basis for comparison is the functional unit which is the quantitative expression for the equal benefit of the systems compared. As can be seen, LCA is product-oriented (including services or, in the most general form, "human activities"). The greatest advantage and progress from the environmental point of view consists of the ability of LCA to detect and account for trade-offs, i.e. the shifting of environmental burdens from one medium to the other and/or from one stage of the life cycle to another. The price to be paid for this and other advantages of LCA consists in a limited spatial and temporal resolution of the analysis.

Another more formal way to look at LCA consists of the consideration of the standard structure developed by SETAC and ISO which refers to a full LCA and includes "Goal definition and scoping", "Inventory analysis", "Impact assessment" and "Interpretation". A comparison with related tools shows that some are closely related to full LCA insofar as they are either shorter versions or more comprehensive methods with the LCA as the core:

- Life Cycle Inventory (LCI) – not to be confused with Inventory analysis – consists of the first two components of LCA and may be followed by an interpretation. A more restricted form of LCI is the "cradle-to-factory gate" LCI
- Simplified or streamlined LCA [1,2]
- Product Line Analysis (PLA) [3] and Social and Environmental Life Cycle Assessment (SELCA) [4] consisting essentially of an LCA plus social and economic assessment along the life cycle.

There is also the much broader concept of "Industrial Ecology" [5] which includes life cycle thinking but encompasses different methods, not only LCA.

Complimentary methods not related to LCA are based on the analysis and assessment of substances or materials and their flows through the technosphere (anthroposphere) and the environment, but not considering the whole life cycles:

- Substance Flow Analysis (SFA) [5,6]
- Input-output analysis ("gate-to-gate" analysis, Betriebsoekobilanz/Company ecobalance [7,13])
- Hazard- and Risk Assessment (RA)
- Environmental Impact Assessment (EIA, not to be confused with Life Cycle Impact Assessment – LCIA).

These methods are often related to environmental management and audit systems (centered around ISO 14000 and 14010) in a similar manner as the "LCA-family" (with ISO 14040 as the core) is related to products and services.

Another well established, broad methodology, not directly related to LCA and not restricted to technical and environmental issues – i.e. including social and economic aspects as well –, is Technology Assessment (TA). TA may include elements of all methods mentioned and has been created primarily for advising politicians.

Some of these methods have the advantage of a better local and temporal context [13]. In favourable cases, therefore, real instead of potential impacts and risks can be calculated, albeit at the expense of life cycle considerations. In the so-called risk assessment of chemicals [8], on the other hand, model environments are used which offer a very limited spatial resolution.

The basic drawback of all these methods, of course, consists of the neglect of life cycle thinking. Very recently, however, we have observed a tendency to include some elements of LCA into SFA, as exemplified in a recent SFA on PVC (SFA + LCIA [9]). Conversely, LCAs dealing with very large product flows (i.e. the functional unit is the sum of all related products of a country) tend to become SFAs. In this case, however, the life cycle aspects are included from the start. Since system expansion has been recommended by ISO 14041 in order to prevent allocation, such large LCAs may be quite common in the future.

Another approach starts from input-output or gate-to-gate analyses of individual production sites (an extremely useful exercise to prepare an eco-audit) which form supply-chains [10,13]. In the end, at least this is the hope, life cycles will be treated instead of simple site-specific assessments lacking any LCA-aspects.

LCIA still has weak points in those impact categories which require toxicity and ecotoxicity modelling; in that case, a better co-operation with chemical RA is requested. This problem and the need to learn much more from the other methods will form a central concern of the section "Ecological Economy & Environmental Technology" during the Annual Meeting of SETAC-Europe in Leipzig, May 1999 [11]. The organisers of this section hope that many colleagues from the related fields will present their methods and results and join the efforts of the LCA-community which will be present in several sessions as usual. Three sessions will be devoted to the LCA/RA interface. This Journal will accept key-papers of the section and continue the discussion about synergistic effects between the different methods.

Another initiative by the European Union has been started recently: CHAINET [12]. It is planned that a guidebook and a network of experts for the "toolbox methods" be developed.

To answer finally the question posed in the title: Of course, LCA **is** unique and so are the related methods which preserve the life cycle approach. It may be useful, however, and in some cases even imparative to combine LCA with other tools or to include life cycle aspects into other methods in order to prevent tradeoffs which may compensate or even reverse positive effects of environmental measures. A lucid analysis of possible combinations of the product-related LCA with organisation-related environmental management tools has recently been given in this Journal by FINKBEINER et al. [13].

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