Chapter 5
Life-Cycle Based Sustainability Assessment of Products

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Abstract  Sustainability was adopted by United Nations Environment Programme (UNEP) in Rio de Janiero as the main political goal for the future development of humankind. It should also be the ultimate aim of product development. According to the well-known interpretation of the original definition given in the Brundtland Report, sustainability comprises three components: environment, economy, and social aspects. These components or ‘pillars’ of sustainability have to be properly assessed and balanced if a new product is to be designed or an existing one be improved.

Depending on the systems to be improved, in the sense of better sustainability, and to the audience(s), i.e. actors or stakeholders, different scientific and practical approaches are being developed. There are notably two directions which can be distinguished: one based on accounting (Environmental Accounting and Environmental Management Accounting—EMA) and another one based on the Life-Cycle Assessment (LCA) of products. In this article, the latter approach is described in the hope of improving the mutual understanding of the two communities and their assessment/accounting tools. The responsibility of the researchers involved in the assessment of sustainability is to provide appropriate, reliable, and up-to-date instruments. For the environmental part, there is already an internationally standardised tool: Life-Cycle Assessment (LCA). Life-Cycle Costing (LCC) is the logical counterpart of LCA for the economic assessment. LCC surpasses the purely economic accounting and cost calculation by taking into account the use- and end-of-life phases and hidden costs. For this component, a guideline is being developed by The Society of Environmental Toxicology and Chemistry (SETAC). It is a very important point that different life-cycle based methods (including Social Life-Cycle Assessment ‘SLCA’) for sustainability assessment use consistent system boundaries.

SLCA has been neglected in the past, mainly due to great methodological difficulties, but is now beginning to be developed. The central problems seem to be
how to relate the social indicators (social impact assessment) quantitatively to the functional unit of the product-system, and how to restrict to a manageable number the many social indicators proposed. Furthermore, a better regional resolution of the Life-Cycle Inventory, compared to conventional LCA, has to be achieved since the social conditions vary geographically much more than, the core element of LCA industrial production.

5.1 Introduction

The sustainable development of humankind (Section 5.2) has to embrace all kinds of human activities, including the manufacture, use- and disposal of products. To achieve this important goal, many human structures and processes have to be improved or replaced and this improvement has to be measured. Different methods have to be compared and the progress—if any—has to be documented as quantitatively as possible. Why is this necessary? The main reason is to make sure that we are going in the right direction. Another one is, given the limited amount of capital available, to make the best use of it in developing new sustainable industries and products.

Depending on the human activities, structures, products, management systems and the angle under which we are assessing and finally the improvement (this has been called ‘attribution’ by Heijungs 2001), different methods have to be and are being developed. One group of methods is the economic tradition of accounting and Environmental Accounting and Environmental Management Accounting (EMA, see previous books of this series Bennett et al., 2002, 2003; Rikhardsson et al., 2005; Schaltegger et al., 2006) and the programmatic survey by Burritt et al., (2003). The second group of methods is based on life-cycle (cradle-to-grave) thinking (SETAC 1993). Life-cycle based sustainability assessment of product systems is considered here as an extension of Life-Cycle Assessment (LCA). It deals with the comparative assessment of goods and services (products). Problems connected with macroeconomic systems are avoided. This is in-line with the original definition and use of LCA as a comparative method of environmental product assessment (ISO 1997; SETAC 1993).

It was decided at the first Society of Environmental Toxicology and Chemistry (SETAC) Europe LCA Symposium in Leiden, December 1991, which the acronym LCA stands (silently) for environmental Life-Cycle Assessment. It was clear from the beginning, however, that a full sustainability assessment would require at least two further dimensions, the social and the economic. The problem of the missing dimensions finally surfaced again, about 15 years and two UNEP world conferences later. The problem is now how to complement LCA in such a way that the economic and the social dimensions are compatible with the environmental.

In the following, sustainability assessment will be treated from the life-cycle perspective in the hope that the environmental accounting community will recognise some potential synergies and common goals as well as problems (allocation, data quality, system boundaries etc.,). Potential links to EMA will be mentioned where appropriate. It is curious to note that the hiatus between monetary and physical