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ANSWER TO A LETTER TO THE EDITOR

Is LCC relevant in a sustainability assessment?

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Abstract In a recent letter to the editor, Jørgensen et al. questioned that life cycle costing (LCC) is relevant in life cycle-based sustainability assessment (LCSA). They hold the opinion that environmental and social aspects are sufficient. We argue that sustainability has three dimensions: environment, economy, and social aspects in accordance with the well-accepted "three pillar interpretation" of sustainability, although this is not verbally stated in the Brundtland report (WCED 1987). An analysis of the historical development of the term "sustainability" shows that the economic and social component have been present from the beginning and conclude that LCSA of product systems can be approximated by LCSA = (environmental) LCA + (environmental) LCC + S-LCA where S-LCA stands for social LCA. The "environmental" LCC is fully compatible with life cycle assessment (LCA), the internationally standardized (ISO 14040 + 14044) method for environmental product assessment. For LCC, a SETAC "Code of Practice" is now available and guidelines for S-LCA have been published by UNEP/SETAC. First examples for the use of these guidelines have been published. An important practical argument for using LCC from the customers' point of view is that environmentally preferable products often have higher purchasing costs, whereas the LCC may be much lower (examples: energy saving light bulbs, low energy houses, and cars). Also, since LCC allows an assessment for different actor perspectives, the producers may try to keep the total costs from their perspective below those of a conventional product: otherwise, it will not succeed at the market, unless highly subsidized. Those are practical aspects whichfinally decide about success or failure of "sustainable" products. Whether or not an analysis using all three aspects is necessary will depend on the exact question. However, if real money flows are important in sustainability analysis of product systems, inclusion of LCC is advisable.

Keywords Life cycle costing · Social life cycle assessment · Sustainability assessment

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In a recent letter to the editor, Jørgensen, Hermann and Mortensen (Jørgensen et al. 2010) questioned the relevance of life cycle costing (LCC) within the framework of sustainability assessment. The authors challenge the widely accepted "Three pillar" interpretation of sustainability, sometimes called "Triple bottom line" (Remmen et al. 2007), saying that it cannot be deduced from the Brundtland report (WCED 1987). The social component is not contested by Jørgensen et al., however, but taken as the one and only addition to the environmental one.

This is a refreshing viewpoint and deserves some discussion.

Jørgensen et al. are correct in saying that the three pillars are not mentioned as such by the World Commission on Environment and Development (WCED), but "Development" has, of course, always contained an economic dimension (formerly considered to be the only major one besides military aid).

Focusing only on social and environmental effects seems to us a misinterpretation of the term sustainability,

derived from the German word "nachhaltig" used originally in forestry (Carlowitz HC von 1713, 2000); as shown by Grober (2010), this concept contained economic and social components from the beginnings. Even the word mutated via the French term "soutenu" (now in addition to "durable") into the English "sustainable" and used as such in preliminary documents before the Brundtland report appeared (Grober 2010). This could explain why the "Three pillar" interpretation appeared almost simultaneously with the famous WCED report. The method "Produktlinienanalyse" (Projektgruppe ökologische Wirtschaft 1987) actually consisted of a proto-life cycle assessment (LCA) (Klöpffer 2006), an economic and a social assessment based on one life cycle inventory (LCI) for the three components.

Based on the firm believe that economic aspects cannot be neglected in life cycle based sustainability assessment (LCSA) (Hunkeler et al. 2008; Klöpffer 2003, 2008; Zamagni et al. 2009), it was proposed by one of us that LCSA is best expressed by the symbolic Eq. 1:

$$\mathrm{LCSA} = (\text{environmental})\mathrm{LCA} + (\text{environmental})\mathrm{LCC} + \mathrm{S\text{–}LCA} \tag{1}$$

In this equation, environmental LCC refers to an economic assessment that is consistent with LCA, and social (S)-LCA, likewise, an assessment of the social impacts along the entire life cycle of a product that fits to the environmental LCA.

The possible alternative of only one method based on a common LCI was discarded as not compatible with ISO 14040+14044 (2006) (Klöpffer 2008; Klöpffer and Renner 2008).

The further development of LCSA will mainly depend on the improvement of the life cycle methods. Whereas LCA is internationally standardised, this is not yet the case for LCC and S-LCA. Progress toward standardisation has been made for both methods, however.

Guidance for environmental LCC is now available as a SETAC "Code of Practice" (Hunkeler et al. 2011). In contrast to traditional LCC, environmental LCC is fully compatible with LCA and allows assessing the costs of product systems from different point of views (or different actors), the view best fitting for comparative product assessments being the one of the product user. But also producers can study the products from their angle, and even national authorities can use the method for their purposes. An important practical aspect from the users point of view is that environmentally friendly products, as identified and quantified by LCA, have often higher purchasing costs, but frequently turn out to be cheaper if the use phase and/or the end-of-life phase are taken into account. Thus, an environmental LCC can help consumers to make good decisions, and it can help producers and merchants to point out the financial advantage of buying an environmentally preferable product. An extreme illustration for this point of view is energy-saving light bulbs, but also low energy houses and cars with less fuel consumption are obvious examples. From the point of view of the producer, it is evident that the LCC should be equal or at least not much higher for environmentally preferable compared to the present products: otherwise, they will not succeed at the market, unless strongly subsidised.

For S-LCA, guidelines have been recently published by UNEP/SETAC, method sheets that describe the modelling and assessment of social indicators corresponding to these guidelines are available, and first case studies are conducted (UNEP/SETAC 2009; Benoît et al. 2010a; Benoît et al. 2010b; Franze and Ciroth 2009; Ciroth and Franze 2010). For example, one case study for cut roses assesses environmental and social impacts for roses grown in the Netherlands and in Ecuador, and finds that environmentally, roses from Ecuador have a much better performance despite air transport to Europe, while from a social life cycle perspective, growing roses in automated greenhouses in the Netherlands is highly preferable (Franze and Ciroth 2009).

So, how to conclude? Good news is that tools for addressing all the dimensions of sustainability are available and also in use. Environmental life cycle costing assesses microeconomic, real money flows only, excluding external or macroeconomic costs; it thereby avoids overlaps with environmental LCA, but also with socioeconomic impacts addressed in S-LCA. Answers provided by LCC are therefore related to the costs directly relevant for the decision maker or to another life cycle actor, over the full life cycle. Should such a question be part of a sustainability assessment? And is such a question interesting to decision makers and to the public?

We think that these questions cannot be answered in general; on the contrary, we believe that it is wrong to state that LCC has no place in sustainability assessment. Rather, in an assessment situation, the question at stake should be analysed, and if microeconomic, real money flows are relevant, then they should be addressed with the appropriate tool, which we believe is, environmental LCC. And finally, the question that was answered and the tools that were used to provide an answer should be communicated with the answer, in order to avoid misleading conclusions.

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