Maintaining quality critical peer review (CPR) as the demand for life cycle assessments increases

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Abstract

Environmental managers and government policy makers are becoming increasingly aware of the need to follow the holistic approach of Life Cycle Assessment (LCA) to move us in the right strategic direction to best achieve environmental sustainability. Along with this realization has been an explosive growth in the number of published LCA studies. Now the LCA community is faced with a serious challenge of meeting the growing demand for critical peer review (CPR) with an adequate supply of available, qualified experts to serve as technical reviewers.

A recent search (by the author) in SCOPUS on the term “life cycle assessment” resulted in 4,500 citations between 1999 and 2010. Further, according to SCOPUS, five journals published the most on LCA (around 1500 papers): International Journal of Life Cycle Assessment (828); Journal of Cleaner Production (256); Journal of Industrial Ecology (159); Environmental Science & Technology (145); and Resource Conservation and Recycling (109).

Looking at CPR of publications versus critical review of LCA studies themselves, this paper addresses key issues the LCA community faces in the peer-review process, namely, the limited number of qualified reviewers, the lack of an agreed-on review process, the growing popularity of the use of life-cycle based approaches, and the use of public databases which requires CPR to be handled in a different manner since reviewers cannot easily review all the underlying data, models and assumptions.

1 Introduction

Environmental managers and government policy makers are becoming increasingly aware of the need to follow the holistic approach of Life Cycle Assessment (LCA) to move us in the right strategic direction to best achieve environmental sustainability. Along with this realization has been an explosive growth in the number of published LCA studies. Now the LCA community is faced with a serious challenge of meeting the growing demand for critical peer review (CPR).

The various aspects of this growing challenge includes: the limited number of qualified reviewers in face of an increasing publication rate; the growing popularity of the use of life-cycle based approaches; the lack of an agreed-on review process; and the use of public databases which requires CPR to be handled in a different manner since reviewers cannot easily review all the underlying data, models and assumptions.

2 Increasing publications on LCA methodology and application

The increasing reach of the life cycle concept into environmental management and sustainability strategies can be seen in the growing number of papers on LCA methodology development and applications that have benn and are being published in technical journals.

Figure 1 shows the increase in the number of publications with the keyword “life cycle assessment” as reported in a search (by the author) using SCOPUS, a bibliographic database containing abstracts and citations from scholarly journals.

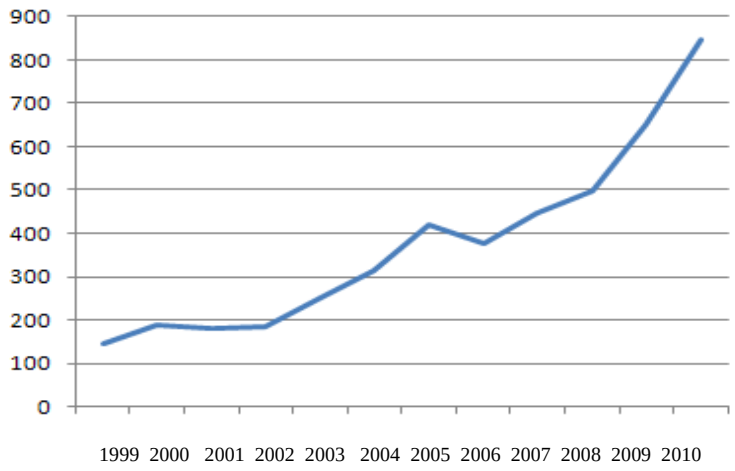

Figure 1. A recent search in SCOPUS on the term “life cycle assessment” resulted in 4,500 citations between 1999 and 2010.

According to SCOPUS, the top five journals have, to date, published around 1,500 LCA and LCA-related papers:

International Journal of Life Cycle Assessment	828
Journal of Cleaner Production	256
Journal of Industrial Ecology	159
Environmental Science & Technology	145
Resource Conservation and Recycling	109

Guinee et al. [1] provide insight into the increasing number of publications in their description of the the development of LCA methodology over the decades since 1970:

- The decades of conception (circa 1970-1990), in which there were widely diverging approaches, terminologies and results.

- The decade of standardization (1990-2000), in which national governments, the Society of Environmental Toxicology and Chemistry (SETAC) and the International Standards Orgaization (ISO) tried to define national or supra-national standards.

- The decade of elaboration (2000-2010), in which many scientists further developed many loose subjects (such as consequential LCA, allocation, land use and ecosystem health), but often in a mutually inconsistent way.

3 LCA and use of the life cycle perspective

As indicated above, the growing interest in LCA has led to a broad diversity of approaches and initiatives. To restate the definition of an LCA, this time taking input from ISO 14040 [2]:

Life Cycle Assessment is a standardized approach to quantifying natural resources used and wastes released to the environment from cradle-to-grave; to assess the potential impact of quantities; and to identify opportunities to affect environmental improvements. That is, to be an LCA, a study must 1) be holistic in scope, 2) be multi-media, and 3) account for all potential impacts to human health and the environment. A detailed assessment usually involves multiple iterations of data collection, impact assessment, and scope definition.

Industrial processes are extensively inter-connected and global making the conduct of an LCA very resource and time intensive. The time and resources that are needed to conduct such a detailed LCA can be cost prohibitive, creating an obstacle to a wider adoption of life cycle approaches, especially among SMEs. As LCA becomes increasingly popular and more LCAs are conducted, more data are becoming available, but gathering reliable inventory data can still be difficult. Furthermore, life cycle impact assessment models vary and additional impact data are needed, especially for new frontiers, such as nanotechnology. Complete consideration of all the interdependencies is impractical, so ways to streamline or simplify the LCA process are desirable. In fact, out of necessity, all LCAs are streamlined to some degree. It is not a question of whether or not streamlining is feasible; it is simply a matter of how much streamlining is appropriate while still leading to meaningful results (that is, reaching the goal of sustainability).

The search for a simplified way to conduct LCA has led to frequent use of terms such as "simplified" or "screening" LCA, as well as referring to the use of "life cycle thinking" in an assessment. Definitions of "screening level LCA" and "life cycle thinking" are offered here.

- *Screening Level LCA* is a simplified application of the LCA methodology in that it is typically a first attempt to collect data and information, e.g., by using generic data, standard modules for transportation or energy production, etc., followed by a simplified assessment.

- *Life Cycle Thinking* considers all the interconnected activities within an industrial system from cradle to grave, i.e., it considers the entire product life. The information may be qualitative, or very general quantitative data may be used. The benefit of using life cycle thinking is to help understand the entire life cycle of the product.

"Life cycle thinking" is the basis of various life cycle-based approaches (other than LCA) that apply the holistic life cycle concept by viewing a product system from cradle to grave (referred to as looking "across the life cycle") but limit the study to a pre-selected area of concern. The popularity of the holistic concept behind LCA has motivated many analysts to model systems from the cradle to the grave (sometimes described as cradle-to-cradle to reinforce the notion of reuse and recycling). Various tools and approaches are being applied to closely examine the production, use, and disposal of products to better understand their potential environmental impact. However, driven either by focused interests or by limited data availability, take a single-attribute approach. These types of life-cycle based studies consider the entire life cycle activities but account only for inputs and outputs of interest. Brief descriptions of two examples, Life Cycle Risk Assessment and Life Cycle Greenhouse Gas Analysis, follow.

3.1 Life cycle risk assessment

Part of EPA's bread and butter, and one of the things that only EPA does in government, is to conduct risk assessments of toxic chemicals and then communicate the risk associated with them to the American people and to product manufacturers. A logical extension is then to integrate the traditional risk assessment paradigm with a life cycle perspective as a way to examine potential human health and ecological impacts (both positive and negative) in a broad, systematic manner. The lifecycle nature of an LCRA approach indicates that it encompasses a cradle-to-grave framework while accounting for multi-media environmental fate and transport, exposure, and effects on both ecological receptors and human health. Other dimensions such as economic, political, security, or societal factors are typically excluded in an LCRA.

3.2 Life cycle greenhouse gas (GHG) analysis

Since much of our energy is produced from petroleum resources, the use of fossil fuels releases carbon that has been stored underground for millions of years and results in a net addition of CO_2 to the atmosphere. Recent awareness and increasing concern over global climate change has driven researchers and practitioners to study carbon dioxide (CO_2) and other greenhouse gas (GHG) emissions on a system-wide basis. Two well-known accounting tools for quantifying and managing life cycle GHG emissions are the Greenhouse Gas Protocol (GHG Protocol) [3] and BSI's "Specification for the assessment of the life cycle greenhouse gas emissions of goods and services" [4]. In 2006, the International Organization for Standardization (ISO) adopted the Corporate Standard as the basis for its *ISO 14064-I: Specification with Guidance at the Organization Level for Quantification and Reporting of Greenhouse Gas Emissions and Removals [5]*.

4 Journal article peer review versus critical peer review of an LCA study

So far, the discussion has been on publications in technical journals. It is important to clarify the distinction between journal review and critical review according to ISO 14040/14044 [2, 6]. This is clear to insiders, and those who are LCA saavy, but perhaps not to all members of the LCA/LCM community. LCAs are published in scientific journals (see the list provided above) but often without having conducted a critical review of the study itself, and the underlying data, assumptions and models, even if comparative assertions have been reported, at least implicitly.

Focusing now on the issue of CPR of journal articles, the following issues need to be addressed by the LCA community as interest in LCA and life-cycle based approaches continues to grow.

- Is CPR adequately keeping pace with the growing number of studies that need to be reviewed? Are the number of new and current LCA experts able to handle the increased demand? What can be done to help the pool of qualified reviewers grow?

- Although it has long been realized that CPR is an essential component of LCA, little guidance has been developed [7]. To maintain the credibility of LCA methodology as a viable environmental management tool, clearer guidance for conducting CPR is needed.

- Reviewers cannot easily review all the underlying data, models and assumptions. Further, the use of public databases requires CPR to be handled in a different manner. How should review be approached in these cases?

- How should CPR of studies that are life-cycle be considered? Is it the responsibility of journal editors and reviewers to maintain the application of LCA as intended by the ISO standards [2, 7]? That is, do we allow life cycle-based studies to be accepted as LCAs?

5 Conclusions

To maintain the credibility of LCA methodology as a viable environmental management tool, clearer guidance for conducting CPR is needed. Especially, it is becoming increasingly important to have a better understanding of how to conduct a peer review of LCA studies, including a process for assessing the data and the life cycle inventories they are based on. More importantly, it will be critical to maintain a pool of qualified reviewers that are easily identifiable and accessible.

6 References

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Disclaimer

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