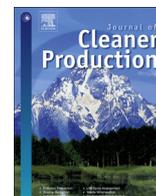




Contents lists available at ScienceDirect

## Journal of Cleaner Production

journal homepage: [www.elsevier.com/locate/jclepro](http://www.elsevier.com/locate/jclepro)

## Making the most of LCA in technical inter-organisational R&amp;D projects

Gustav Sandin<sup>a,b,\*</sup>, Gunilla Clancy<sup>b</sup>, Sara Heimersson<sup>b</sup>, Greg M. Peters<sup>b</sup>,  
Magdalena Svanström<sup>b</sup>, Marieke ten Hoeve<sup>c</sup><sup>a</sup> SP Technical Research Institute of Sweden, Department of Wood Technology, Brinellgatan 4, Box 857, SE-501 05 Borås, Sweden<sup>b</sup> Chalmers University of Technology, Research Group of Chemical Environmental Science, Kemivägen 10, 412 96 Gothenburg, Sweden<sup>c</sup> University of Copenhagen, Department of Plant and Environmental Sciences, Thorvaldsensvej 40, 1871 Frederiksberg C, Denmark

## ARTICLE INFO

## Article history:

Received 14 June 2013

Received in revised form

9 November 2013

Accepted 30 January 2014

Available online xxx

## Keywords:

Life cycle assessment

Environmental assessment

Project management

Project characteristics

Project planning

Research and development

## ABSTRACT

In technical Research and Development (R&D) projects, a Life Cycle Assessment (LCA) of the technology under development is sometimes carried out. Particularly in inter-organisational R&D projects, the roles of LCAs tend to be unclear and arbitrary, and as a consequence, LCA work is not adequately designed for the needs of the project. There is a need for research on how to choose an appropriate role for LCA in such projects and how to plan LCA work accordingly.

We have identified some possible roles of LCA in inter-organisational R&D projects and used experiences from LCA work in different such projects to identify four project characteristics that are decisive for what roles the LCA can have. The project characteristics are: (i) the project's potential influence on environmental impacts, (ii) the degrees of freedom available for the technical direction of the project, (iii) the project's potential to provide required input to the LCA, and (iv) access to relevant audiences for the LCA results. We discuss how evaluation of these project characteristics can help project commissioners, project managers and LCA practitioners to deliberately choose appropriate roles of LCA in inter-organisational R&D projects and plan projects for efficient use of LCA.

© 2014 Elsevier Ltd. All rights reserved.

## 1. Introduction

In technical Research and Development (R&D) projects, Life Cycle Assessments (LCAs) are sometimes carried out on the technology under development. For inter-organisational R&D projects funded, partly or fully, through publicly funded R&D programmes, such as the European 7th Framework Programme, there is sometimes even a requirement to conduct an LCA (Tilche and Galatola, 2008). However, according to our experiences as LCA practitioners in such projects, requirements or recommendations on the exact roles of LCA are seldom provided. The topic of this paper is how to clarify the roles of LCA in such projects, and thereby improve project planning for utilising the full potential of LCA for assessing environmental impacts and influence technology development and decision-making.

\* Corresponding author. SP Technical Research Institute of Sweden, Department of Wood Technology, Brinellgatan 4, Box 857, SE-501 05 Borås, Sweden. Tel.: +46 72 245 5374.

E-mail addresses: [gustav.sandin@sp.se](mailto:gustav.sandin@sp.se), [gustavsandin@hotmail.com](mailto:gustavsandin@hotmail.com) (G. Sandin), [clancy@chalmers.se](mailto:clancy@chalmers.se) (G. Clancy), [sara.heimersson@chalmers.se](mailto:sara.heimersson@chalmers.se) (S. Heimersson), [petersg@chalmers.se](mailto:petersg@chalmers.se) (G.M. Peters), [magdalena.svanstrom@chalmers.se](mailto:magdalena.svanstrom@chalmers.se) (M. Svanström), [mtho@life.ku.dk](mailto:mtho@life.ku.dk) (M. ten Hoeve).

<http://dx.doi.org/10.1016/j.jclepro.2014.01.094>

0959-6526/© 2014 Elsevier Ltd. All rights reserved.

## 1.1. LCA in R&amp;D

LCA is, in principle, a suitable tool to use in technical R&D processes for environmental assessment of emerging technologies or preliminary product designs, as ISO 14040 supports an iterative process of upgrading the LCA as new data becomes available (SIS, 2006a,b). Much research has been conducted on how to carry out LCAs and other sustainability assessments in R&D processes (e.g. Askham et al., 2012; Byggeth et al., 2007; Clancy et al., 2013; Collado-Ruiz and Ostad-Ahman-Ghobari, 2013; Colodel et al., 2009; Devanathan et al., 2010; Fleischer et al., 2001; Manmek et al., 2010; Ny, 2006; Othman et al., 2010; Rebitzer, 2005; Vinodh and Rathod, 2010; Waage, 2007). Much of this literature suggests screening or simplified LCAs for the assessment of emerging technologies or preliminary product designs, or approaches for use in specific case studies. Critiques of using LCA in R&D are also found, for example, Millet et al. (2007) concluded that LCA is not an appropriate tool for the product design process (typically a late phase in product development). They did not, however, focus on earlier stages of product development or inter-organisational contexts and did not discuss LCA roles beyond guiding the development process (we list other possible roles in Section 3.1). There is also more general (i.e. not LCA specific) research on consideration of environmental issues in R&D, often with

a focus on intra-organisational contexts. See [Baumann et al. \(2002\)](#) for a review on early research in intra-organisational “environmental product development”, or [Johansson \(2006\)](#) for a study on characteristics of intra-organisational R&D projects in which environmental concerns are addressed. Little attention has, however, been put on how to apply LCA in *inter-organisational* R&D projects – the topic of this paper.

### 1.2. The context of publicly funded inter-organisational R&D projects

A common setting for LCA work in Europe is publicly funded inter-organisational R&D projects, for example funded by national governments or by the European Union (EU) in the 7th Framework Programme. In many such projects, sustainability is one of the stated driving forces, and therefore it is relatively common to carry out LCAs, often as part of a wider sustainability assessment. However, the primary focus of the project work is typically on technical R&D, and LCA work is typically allocated a minor share of the funding. The projects often involve a mix of universities, firms and research institutes from different countries and knowledge fields, with varying reasons for joining the project and various expectations on the project outcome. This contributes to a high degree of organisational and cultural complexity. Complexity is further enhanced because of multiple research activities being carried out to solve different aspects of a technical problem, in which it becomes difficult to get an overview and complete understanding of how different activities will interact and contribute towards the aim of the project. These projects are often also characterised by a focus on specific technical ideas or solutions, as it is required to present a well-developed technical idea or solution to attract the funding. Once the funding has been secured, the application text (including milestones and deliverables) and the competences of the project team often set limitations to what can be done in the project.

### 1.3. Aim and content

The high complexity and the technological lock-in described above put high demands on pre-project planning. According to our experiences from such projects, pre-project planning of LCA work can be greatly improved. In particular, the roles of the LCA tend to be unclear and arbitrary, sometimes resulting in differing and even contradicting expectations on the LCA outcome among project partners, and LCA work not being optimally performed in relation to its potential in different projects. This may largely be a result of the strong focus on technical R&D work among those initiating and leading the projects – LCA becomes an add-on and does not receive appropriate attention. Even with vast experience and strong negotiating skills, the LCA practitioner may be forced to accept a reality in which the role of the LCA is greatly reduced in comparison to its full potential to assess environmental impacts and influence technology development and decision-making. There is thus a need to increase awareness of the potential of LCA, facilitate the selection of appropriate LCA roles and formulate guidance of how to plan the project accordingly.

In the present paper, we identify project characteristics which are decisive for the roles of LCA in the above described project context. We discuss how these characteristics relate to our experiences of LCA work in five specific projects, whereof one project is used as a starting point for a more elaborate discussion on how the evaluation of the project characteristics can be used in practice. The purpose of the paper is thus to help project commissioners, project managers and LCA practitioners to clarify which LCA roles that are available for their project, choose appropriate roles based on the needs or requirements of project commissioners and participants, and plan the project for better use of LCA. Many of the presented

findings are almost certainly available as tacit knowledge amongst LCA practitioners, but there is a need to formalise this type of meta-knowledge existing in the LCA community into written research findings in order to make it more accessible and further improve the use of LCA in practice.

Some of our recommendations are similar to the ISO 14044 recommendations on how to define the goal and scope of an LCA ([SIS, 2006a](#)). Our recommendations are, however, about how to plan projects for better use of LCA, preferably already in putting together the project team and writing the project application, a process normally occurring prior to the goal and scope definition. Besides, the findings are addressed not only to LCA practitioners but also to others involved in project management, who in general are not familiar with ISO 14044.

Although the findings are primarily derived from experiences in European publicly funded inter-organisational projects, the findings may also be of interest for privately funded as well as non-European inter-organisational projects, as is further discussed in Section 3.4.

The terminology used in the paper in terms of roles of LCA in technical R&D projects is illustrated in [Fig. 1](#). The paper strives to help project managers and LCA practitioners identify the *available roles* for their project out of all *possible roles* and guide them in planning the project in accordance with *chosen roles*. It is assumed that if roles are deliberately chosen, it is more likely that they can be fulfilled.

## 2. Method

To provide practical guidance on how to choose appropriate LCA roles in inter-organisational R&D projects and plan the project accordingly, we explore the literature and our experience of work in these types of projects. In particular, we analyse the five projects described in Section 2.2, but we also draw on our experience from many other similar projects (e.g. [Alvarez-Gaitan et al., 2013](#); [Fröling et al., 2006](#); [Johansson et al., 2008](#); [Peters et al., 2011](#)). The methodology applied in this analysis is described in Section 2.1.

### 2.1. Methodology

Analysis and data collection were done iteratively and in parallel, a procedure that can be described as a constant comparative approach ([Glaser, 1965](#); [Silverman, 2005](#)). The iterative procedure involved the following steps:

- Identification of the many possible roles of LCA in technical R&D projects, using (i) literature, (ii) written descriptions of the five projects described in 2.2, and (iii) experiences of LCA practitioners (the authors). This way of using different types of data sources to get multiple perspectives on a research topic is called triangulation (see e.g. [Denzin, 1978](#); [Peters et al., 2013](#)).
- Identification of the chosen roles, explicit or implicit, according to pre-project descriptions of project work and the roles that were partly or fully realised for the LCAs in the five projects. The following data sources were utilised in the analysis: (i) written descriptions of the projects and their outcomes – ranging from early versions of project proposals to the final description of work and subsequently updated detailed project plans and results – and (ii) hands-on experience of participation in the writing process for the project proposals and of participation as LCA practitioners in the projects.
- Identification of the project characteristics that support or limit the availability of certain roles, by exploring reasons for why some LCA roles were not realised in the five projects and why other roles were partly or fully realised.

متن کامل مقاله

دریافت فوری ←

**ISI**Articles

مرجع مقالات تخصصی ایران

- ✓ امکان دانلود نسخه تمام متن مقالات انگلیسی
- ✓ امکان دانلود نسخه ترجمه شده مقالات
- ✓ پذیرش سفارش ترجمه تخصصی
- ✓ امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
- ✓ امکان دانلود رایگان ۲ صفحه اول هر مقاله
- ✓ امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
- ✓ دانلود فوری مقاله پس از پرداخت آنلاین
- ✓ پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات