Systematic literature review in social life cycle assessment

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Abstract

Purpose: The main purpose of this review is to investigate the methodology of Social Life Cycle Assessment (SLCA) through its application to case studies. In addition the following research aims to define the trends related to the SLCA by researchers and consultants. This study will help to map the current situation and to highlight the hotspots and weaknesses of the application of the SLCA theory.

Methods: The SLCA could be considered as a useful methodology to provide decision support in order to compare products and/or improve the social effects of the life cycle of a product. Furthermore, the results of the case studies analysed may influence decision makers significantly. For this reason, a systematic literature review of case studies was carried out in which SLCA was applied in order to analyse closely the application of the stages of this methodology. In this study, the major phases of the technical framework for a SLCA were analysed. Specific attention was paid to detect the positive impacts that emerged in the case studies, which were also studied by administering a questionnaire to the authors of the analysed case studies and to a number of experts in the field of SLCA.

Results and discussion: The 35 case studies examined in this paper, even though they do not deviate from the 40 identified by the previous processing, are still significantly different in terms of outcome produced. It is important to clarify that the authors who developed the case studies considered the steps defined in the UNEP/SETAC Guidelines, borrowed from the ISO 14044 standard.

*Conclusion*s: The data resulting from this analysis could help both practitioners and researchers to understand what the issues are, on which it is still necessary to investigate and work, in order to solidify the SLCA methodology and define its role in the context of Life Cycle Sustainability Assessment (LCSA).

Keywords Case studies • SLCA • Social life cycle assessment • Systematic literature review

1 Introduction

The need to integrate the Life Cycle Assessment (LCA) with the social aspects that led to the Social Life Cycle Assessment (SLCA), dates back to 15 years ago. Since then, there is certainly much increased interest around the social impacts of products, in order to promote sustainability. According to Jørgensen (2013), the SLCA still needs to prove that "works" before it can be considered to be out of its infancy.

SLCA is a social (real and potential) impact assessment method (Macombe et al. 2011) that aims to assess the social and socio-economic aspects of products and their positive and negative impacts along their life cycle encompassing extraction and processing of raw materials; manufacturing; distribution; use; re-use; maintenance; recycling; and final disposal (UNEP/SETAC 2009).

The objective of this paper is to take stock of the situation on the application and development of SLCA 6 years after the publication of the "Guidelines for Social Life Cycle Assessment of Products" (UNEP/SETAC 2009), in order to see how the SLCA methodology has evolved up to the present. Based on the previously developed studies (Di Cesare et al. 2014; Petti et al. 2014) a review of the case studies that have used the SLCA methodology was carried out (for the complete list see Table 1).

The objectives of this study were pursued by performing a systematic review. The purpose of using this method is to reduce the subjectivity in drawing conclusions (Zamagni et al. 2012): in fact, a systematic review may be defined as a "structured evaluation of the literature with the goal of answering a specific research or application question with a synthesis of the best available evidence. Generally published to share these results with a wide audience for consideration and implementation." (Zumsteg et al. 2012, p13).

2 Methodological issues

The very first phase of the work consisted in the research and implementation of a rigorous and well-defined method, in order to structure the systematic review in a better way. The importance given to the definition of this method arises from the fact that a systematic review is a research method; indeed, the results that it reaches arise from information already described in the published literature. A systematic review is set up as a comprehensive review (and, where possible, a full one) of published articles, selected to address a specific question, which uses a systematic method to identify relevant studies, in order to minimise distortions and errors (Jesson and Lacey 2006). For this reason, the study of the main methods available in literature to implement a systematic review was performed. The presented systematic review mainly took into account the following methods: "Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines. The PRISMA Statement" (Moher et al. 2009) and elaboration document (Liberati et al. 2009); Standardized Technique for Assessing and Reporting on Reviews of Life Cycle Assessment (LCA-STARR) (Zumsteg et al. 2012); "Guidelines for Systematic Evidence Review and Synthesis in Environmental Management" (Collaboration for Environmental Evidence 2013). The mentioned methods are in some aspects very similar, but they differ in the steps of the research that most define the object under analysis. Indeed, while the PRISMA method was born and developed in the medical field, STARR-LCA has its object of study in LCA, and the last mentioned method was developed as part of environmental management.

In light of the systematic review methods of the aforementioned literature, the systematic review carried out in this paper, was conducted according to the following steps: Identification, a double Screening and Eligibility. Step 1: The

case studies were selected. Step 2: The full text of all documents potentially eligible was evaluated based on previously identified criteria for inclusion/exclusion. Step 3: The papers (both the included and the excluded ones) were again screened by each author of this paper, independently. Step 4: The papers to be taken into account were identified (for the full list refer to Table 1).

2.1 The research questions

Crucial issues are the kind of information that must be taken into account. As shown by all the considered methods, a systematic review should be structured around a specific question.

The general research question addressed in this paper is "Which is the state of the art of the application of S-LCA method 6 years after the publication of the Guidelines in 2009?" To better finalize this question, it has been split into the following ones:

- Which was the number of case studies on S-LCA published from 2010 to 2015?
- Which are the objects under study?
- Which are the sectors of application in which the case studies take place?
- Which are the geographical areas concerned?
- Which type of System Boundaries (SB) and Impact Assessment methods are used in the case studies?
- Which are the stakeholders categories considered?
- What kind of positive impacts emerge in the case studies?

2.2 Inclusion and exclusion criteria

The parameters for identifying the case studies are essential in order to answer the research questions and to reduce the likelihood of bias. These criteria (Table 2) made it possible to include or exclude case studies emerging from the research databases.

The main inclusion criterion regarded the methodology used to assess the social impacts: only those papers applying SLCA were included in the review.

Despite the fact that grey literature[1] is abundantly used nowadays, thanks to its easy distribution, the decision not to include it in this systematic review was likely to lead distortion due to the absence of a quality control of the papers themselves, which is instead guaranteed in peer-reviewed publications.

As shown in Table 2, the included studies cover a time span ranging from 2009 to 2015. As the publication of the Guidelines dates back to 2009, it was decided not to consider the first applications of SLCA (Labuschagne and Brent 2006; Manhart and Grießhammer 2006), even if these have been an incentive and an important practice for the following developments.

2.3 Sources selection and search

The analysed case studies were collected through the following search engines: Google Scholar, Scopus database and inter-database Discovery Service (powered by EBSCO Host) accessed by the University "G. d'Annunzio". As shown in Table 3, the search was applied to titles and abstracts, using "AND/OR" operators. More precisely, the research on

[1] According to Farace and Frantzen (2005) grey literature regards "information produced on all levels of government, academia, business and industry in electronic and print formats not controlled by commercial publishing i.e., where publishing is not the primary activity of the producing body" and includes the following documents: technical and project reports, working papers, discussion papers, technical manuals, information sheets, conference papers, theses, etc.

Scopus was performed in: article title, abstract, keywords; in Google Scholar selecting "anywhere in the article"; in Discovery selecting "all text".

3 Results and discussion

Although the current research represents the evolution of previous papers (Di Cesare et al. 2014; Petti et al. 2014), it completely revises the case studies that were previously taken into account by modifying the system of analysis along with the criteria for inclusion and exclusion. For the 35 case studies analysed in this paper, even though they do not deviate from the 40 identified by the previous processing, they are still significantly different in terms of outcome produced. It should also be pointed out that among those 35 cases, 2 of these (Ekener-Petersen and Finnveden 2013; Ekener-Petersen and Moberg 2013) consist of the first and the second part of the same study (the first part presents the social hotspots of a generic laptop while the second part discusses the usability and applicability of the methodology proposed in the Guidelines based on the study), and were thus considered as a single study; from this point on 34 papers will be referred to.

It is important to clarify that the authors who developed the case studies considered the steps defined in the UNEP/SETAC Guidelines, borrowed from the ISO 14044 standard.

50 % of the case studies was published in the International Journal of Life Cycle Assessment (Fig. 1) and 20 % in the Journal of Cleaner Production. These are followed by: Sustainability 7 %, the Journal of Industrial Ecology 7 % and seven other Journals, which altogether account for 17 % (Resources Conservation and Recycling, Materiaux and Tecniques, Energy Policy, Integrated Environmental Assessment, New Medit Journal Impact Factors, Environmental Development, Procedia CIRP); two case studies are published in a collective volume, edited by Muthu (2015) (Revéret et al. 2015; Nemarumane and Mbohwa 2015), and a case study (Ciroth and Franze 2011) in a book edited by Green Delta TC.

76 % of the case studies apply the SLCA methodology, while 24 % use the full methodology of LCSA.

LCSA is defined as the integration of the E-LCA (Environmental LCA), S-LCA and LCC (Life Cycle Costing) methods (Shau et al. 2011; Busset et al. 2014).

3.1 Temporal trends

In 2013, the year of publication of "The Methodological Sheets for Subcategories in Social life cycle assessment (SLCA)", there was an increase of 700 % of the publications (Fig. 2), compared with the number of case studies published in 2012, followed in 2014 by a setback (-60 %). The reason for this is probably that the methodology is still incomplete and requires further development (Jørgensen 2013). It is also known that 2014 was an important year for the scientific community that deals with the SLCA, thanks to two important meetings: the SETAC Europe 24th Annual Meeting (in Basel) and the 4th International Seminar on SLCA (in Montpellier) (Macombe and Loeillet 2014). Many of the papers presented in these events will be published on scientific Journals during this year. Indeed, since the early months of 2015 there was an increase in case studies, with the publication of eight new papers, which have already exceeded the number of the ones in 2014 (six).

3.2 Object of study

The object of study of the analysed papers was grouped into three different areas (Fig. 3): 56 % regard a product (the analysed products are in 26 % of cases in the "food" category), 41 % studied a service and 3 % analyse a process.

3.3 Sector of application

As for the field of application in which the considered case studies were performed, the two most explored are manufacturing, with a percentage of 26 %, and agriculture, 26 % (Fig. 4). While in the remaining papers, 24 % of case studies was found to be in the energy sector, e.g.: photovoltaic (Traverso et al. 2012; Yu and Halong 2015) and bio-fuel (Macombe et al. 2013; Manik et al. 2013; Ren et al. 2015); 21 % in the waste management sector and one study dealt with tourism (Arcese et al. 2013).

A thorough reading of this data shows an unforeseen perspective: it was expected that the scope of the most interested sectors would be of high risk social and socio-economic problems, while the sectors analysed, appear to be the areas with a strong environmental aspect. This is probably due to the fact that SLCA was born as part of a broader assessment of goods and services with a view to sustainable development. Within this overall assessment, the (E-LCA) and SLCA definitely have a lot in common. Indeed, the Guidelines (UNEP/SETAC 2009) clearly state the differences between the two methods in the first pages. This may have resulted in an interpretation that promotes focus on practitioners in sectors with environmental stakes.

3.4 Geographical area

Following the classification fundable in UN (2014), the authors calculated that the 48 % of case studies are implemented in "developing economies", while the 46 % in "developed economies". This demonstrates as the "social context" doesn't influence the number of studies developed in a particular geographical area.

For the 34 analysed case studies, Europe can be certainly regarded as the continent in which most of them are concentrated (Fig. 5). In this analysis, all the countries were taken into account and considered individually, even when the supply chain of a product was distributed in various continents; in three papers the reference was to the World.

It is interesting to note that the continent in which most of the research is conducted is Europe, with its low levels of risk in social or economic concerns. Perhaps due to the fact that, according to Mattioda et al. (2015), the highest concentration of researchers is located in the Old Continent: Denmark, Sweden, Netherlands and Germany. Another valid reason may be the difficulty in finding certain types of data (especially qualitative and those being socially sensitive) in developing countries.

Nevertheless, there is hope that in the future, the SLCA will be increasingly applied in those fields and in those places where it can contribute, effectively and efficiently, to improve the conditions of the stakeholders involved.

3.5 Main methodological issues.

The main methodological issues that SLCA borrowed from E-LCA assume, however, as part of this methodology, a different importance when dealing with data and semi-quantitative and qualitative indicators. Indeed, as the Guidelines clarify, when dealing with this kind of data, the impacts will not be expressed in relation to the Functional Unit (FU). In this regard, even some authors (e.g. Zamagni et al. 2011) spoke in favour of a non FU-based SLCA perspective.

In 6 % of the cases, the functional unit (FU) is not specified as well as the system boundaries, whereas the reference flow is not specified in 79 % of cases.

In one of the analysed papers (Umair et al. 2015), the authors, having used only qualitative data in their research, state that the impacts cannot be expressed in a FU, while in other two cases (Manik et al. 2013; Nemarumane and Mbohwa 2015), the FU is not specified.

Furthermore, concerning the SB, one should remember that scientific evidence is still necessary regarding the ability to define the boundaries in SLCA, such as in E-LCA; indeed, as Lagarde and Macombe (2013) suggested, these are not always identical.

In 24 % of selected papers, the SB is divided into and restricted to single phases of the life cycle (Fig. 6). In addition the SB is defined as a reference system without however considering, some of the important processes, such as transport (Nemarumane and Mbohwa 2015; Umair et al. 2015). In one of the case studies (Macombe et al. 2013), the assessment of biofuel from three different raw materials is carried out at three different levels: company, regional and state level.

The SB was considered “from cradle to gate”. Nevertheless, the predominant trend remains that of a SB "from cradle-to-grave" (32 %) and "from cradle-to-gate" (41 %), as it is desirable for a complete life cycle-based approach.

The Impact Assessment (IA) is definitely the most fragmented phase: as shown in the paper of Wu et al. (2014), there are many different IA methods, which can use Type I and Type II impact categories[2]. This may be due to the fact that the SLCA method was only drafted and not standardized (Zamagni 2012). This has caused a proliferation of models and/or different techniques, also by the same author, which can be deemed useful as the demand for SLCA impact assessment methods could no longer wait for a scientific and shared method (Macombe et al. 2013).

As there is no question about the complexity of the matter and the need for further study, the authors stress the need (as emphasised by Macombe et al. 2013) at first to allocate a clear and shared meaning in important terms such as "social performance", "social effects" and "social impacts"[3]. Particular attention should be paid to the latter concept, often confused with "social effects", partly because of the difficulties to make a scientifically complete analysis.

It appears, from this review, that in 5 cases (Foolmaun and Ramjeewon 2013a; Martínez-Blanco et al. 2014; De Luca et al. 2015; Revéret et al. 2015; Umair et al. 2015), more than one IA methodology[4] has been applied, and five new IA methodologies were developed and presented (Ciroth and Franze 2011; Aparcana and Salhofer 2013a; Ekener-Petersen 2013; Foolmaun and Ramjeeawon 2013a; Ren et al. 2015). The Social Hotspot Database (SHDB) (Benoît-Norris et al. 2012) was used in four cases (Ekener-Petersen et al. 2014; Martínez-Blanco et al. 2014; Rugani et al. 2014; Revéret et al. 2015), two of which (Martínez-Blanco et al. 2014; Revéret et al. 2015) was used in combination with other methods: Life Cycle Working Environment (LCWE) and Potential Hotspot Analysis (PHA).

The stakeholders mostly taken into consideration are Workers with a percentage of 32 % and the Local Community (24 %). In contrast, the less considered are Value Chain Actors (8 %) and Consumers (7 %). In 6 % of the cases, the stakeholders mentioned are not explicitly taken from the Guidelines, while 4 % are not specified at all. That which immediately comes to evidence is the lack of consideration of the Value chain actors, central to a comprehensive life cycle approach.

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[2] “Type I” IA method assesses social impacts on the base of a score that is attributed by using performance reference points, taken from international and national standards and best practices. Also internationally accepted minimum performance levels are taken as a reference (e.g. those contained in ILO conventions, ISO 26000 guidelines and OECD Guidelines for Multinational Enterprises) (Parent et al. 2010)."Type II", closer to E-LCA, assesses social impacts identifying the relations between cause and effect, called pathways, including an easily observed variable and the effect or impact related to it. Pathways are formulated on the basis of scientific evidence (Parent et al. 2010; Chhipi-Shrestha et al. 2014).

[3] “Social impacts” are caused by changes in the context, which originate effects related to changes in life expectancy, health, social status etc. Because of the difficulty of the authors to obtain all data useful for calculations, they stopped at an intermediate point, therefore neglecting the evaluation of a part of the impacts. To acknowledge the inability to calculate the true social impact when this concern is relevant, the term “social effect” instead of “social impact” will be used. “‘Social performances’ are neither social effects nor social impacts of changes. Social performances are […] features of a situation in a relevant organisation (or features of the value chain of organisations shaping the life cycle), referring more or less to social issues" (Macombe et al. 2013:205).

[4] Can be defined as “methodology” a guideline for solving problems, through specific components (e.g. phases, tasks, methods, techniques and tools) (Robson 1997).

The importance of the value chain in the Life Cycle Thinking (LCT) approach is the full range description of activities which are required to bring a product or service from its conception, through the different phases of production and delivery, to its final consumers and end-of-life management.

3.6 In search of positive impacts: a questionnaire to explore positive impacts

In the analysed SLCA studies, the evidence of at least one positive impact occurs in 59 % of cases, neither a negligible figure nor a confirmation of the existence of both research and analysis of positive impacts in practice. Moreover, most of the social issues in the present Guidelines have negative impacts (Ekener-Petersen 2013). In addition, SLCA definitely completes the E-LCA regarding the social and socio-economic aspects, but, as it is clear that the social consequences of a supply chain are different from their environmental impacts (Clift 2014), equally all impacts detected by the two methods should be considered in different ways. The two methods differ in the meaning they give to the term "impact": in E-LCA impacts are almost seen as negative, even if positive environmental impacts emerge; in principle, when looking at the environment it is better not to have impacts at all (UNEP/SETAC 2009). Instead, in SLCA, this vision has helped to consider the absence of negative issues, such as child labour, already assessed as a positive impact (Jørgensen et al. 2008; Ciroth and Franze 2011)[5]. Of course, for some authors, the problem is already in the definition of positive impacts, as they consider similar to environmental ones. These impacts can also be seen as "related to issues that may add value in themselves, such as job creation or capacity building" (Ekener-Petersen 2013:44). The sum of positive impacts that a product, people or organisations create, can constitute the so-called "Handprint". A handprint of people or organisations shows that it is possible to have a net positive impact, when the good done and the positive changes promoted are larger than their Footprint[6] (Norris 2013). This perspective triggers a positive loop in spreading positive impacts.

The outlined view is confirmed in the questionnaire prepared by Petti et al. (2014), which was filled in by 20 authors of papers and experts in the field of SLCA. When asked about the definition of a positive social impact the replies were split between those who would define it as a net positive effect of an activity on a community and the well-being of individuals and families, and those who see it more as a performance that goes beyond compliance. Moreover, the question on whether a positive social impact is merely an improvement related to the previous situation, 50 % of those interviewed agree, 39 % neither agree nor disagree, 11 % do not agree. For 76 % of them, the classification of an impact as "positive" can be regarded as a subjective issue whereas the 90 % consider it to be context-related. The 84 % affirms that positive social impacts have to be assessed as in the case of negative ones, 11 % disagree and 5 % have no opinion on this. In all of the analysed case studies positive impacts have been identified by the authors, but how these were detected appears to be a universe of heterogeneous methods and techniques. Surely, there is no agreement on whether the UNEP/SETAC subcategories can also be regarded as positive impacts or whether or not, it would be necessary to set new subcategories in order to identify positive social impacts. Regarding the introduction of new subcategories, one of the experts suggested using the cause-effect relations, already studied and certified in social sciences, in order to develop positive social pathways. Surely, all the interviewees agree that researching in the context of positive impacts is useful to the general research advancement on social impacts.

[5] Jørgensen et al. (2010) consider the child labour indicator as a context-related positive impact, given that it can be considered as a positive impact in some situations (e.g. helping children to develop discipline, responsibility, self-confidence and independence, teaching them how to manage money, and providing them with working skills) (Di Cesare et al. 2016).

[6] Footprint is defined as the sum of "all the negative impacts of pollution released and resources consumed over the entire supply chain and life cycle of the product" (Norris 2013, p 125)

Positive impacts were not considered in 47 % of the analysed cases; this was not because the products/services under study had no positive impacts of any kind, but because the authors did not specify them. In the remaining 53 % of the cases, positive impacts are recorded and cited; they are identified in 20 subcategories, 76 % of which are attributable to the UNEP/SETAC ones (Benoît-Norris et al. 2013) and closely related to the stakeholders. Local employment is considered an important positive impact with a percentage of 21 %, followed by: 13 % for improved health and safety, 11 % for increase in economic development, 5 % for better working conditions, increased consumer privacy and technology development, 3 % for decrease in child labour, increase in the freedom of association, increased transparency, decrease in forced labour, equal opportunities, access to material and immaterial resources. The remaining 24 % of the positive impacts (non attributable to the UNEP/SETAC subcategories) are: increased income, cooperation contracts, diversification, psychological working conditions, social acceptance, improved physical area reputation, improved environmental impacts and access to information.

4 Conclusions and lessons learnt

The development of literature and the increase in the number of implemented case studies are helping the growth and widespread use of LCT and of the life cycle-based methodologies, in such a way so as to allow the E-LCA, Life Cycle Costing (LCC) and SLCA to play a central role in helping to define the best policy options that lead to sustainable development.

In light of this key mission, it is important to emphasise that a great interest on social issues and LCT is observed. Such attention is, however, more directed to social issues rather than the methodology of the SLCA itself.

Even as regards the main methodological issues, what emerges is a lack of a complete definition. This is particularly evident when the methods of IA are analysed and the difficulty in identifying a unique and shared method is denoted. This probably stems from the fact that currently in the Guidelines, there is no detailed list of methods for the implementation of the IA stage (especially for the retrieval and processing of qualitative data) that are promoted by the Taskforce. This confusion also arises from the misunderstanding on the goal and scope of SLCA, which is sometimes regarded as Corporate Social Responsibility (CSR), forgetting that SLCA was developed to consider impacts vertically (through the supply chain). CSR, on the contrary, makes "horizontal" assessments; the focus is, indeed, on the impact of "an" organisation (Choi 2015).

As shown by the questionnaire on positive impacts, if there is no clarity on the definition, it will definitely be difficult for the techniques to detect these impacts. The IA in SLCA is context-related, and this is even more evident in positive impacts, since social issues (like child labour) are not always negative if, for example, they allow and encourage education. What can be hoped for, is therefore a careful assessment which is able to capture all the possible positive impacts, giving value to local peculiarities that can be solutions to social issues, with a perspective of assessing what can allow and encourage the growth of human capital as a real opportunity for sustainable development.

The real question is, what does SLCA and more in general LCT represent? The answer lies in that, alone, one cannot obtain results and the winning logic to manage the production of goods and services (especially in an era of globalisation) is to open up and create "alliances" with the other stakeholders involved in the value chain, while respecting and protecting the identity of each one. By doing so, SLCA, as all LC-based methodologies, educate and instil the systemic logic of relationship and mutuality, where if the “other” does well, it represents the good.

It is therefore necessary to clarify, as much as possible, the outlines of the methodology, in order to concentrate all the efforts towards a greater clarity for the fundamental task of education that SLCA has in building sustainability.

Compliance with Ethical Standards The authors declare that they have no conflict of interest.

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Figures

Fig. 1– Scientific Journals on which the case studies were published

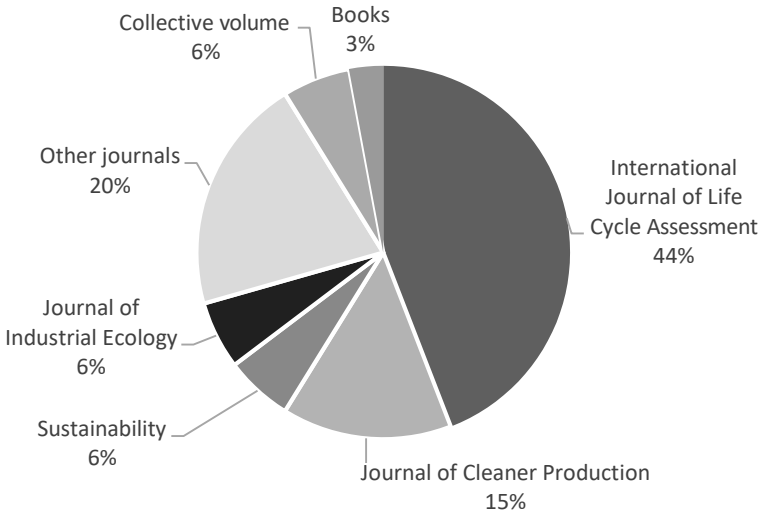


Fig. 2 Temporal trends of the studies within inclusion criteria

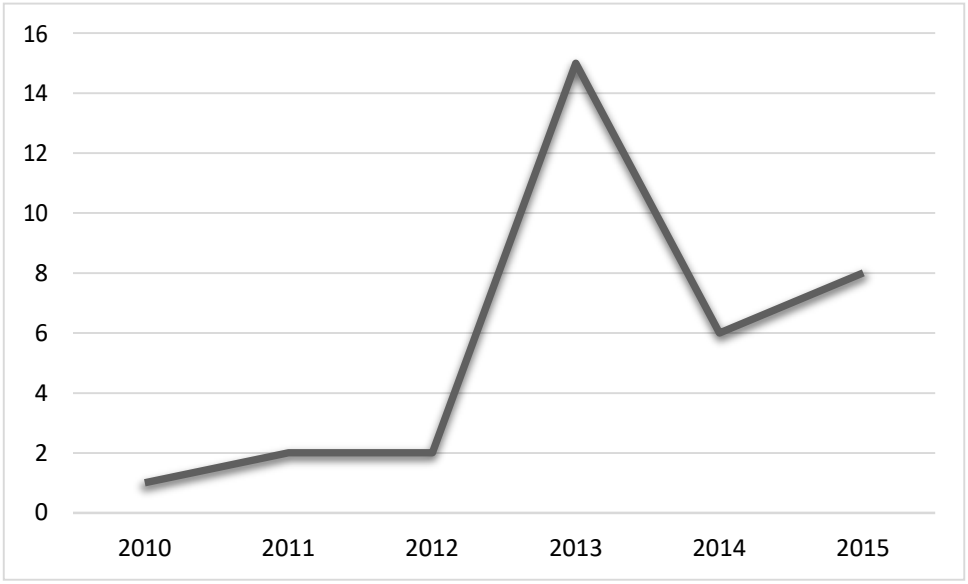


Fig. 3 Object of study

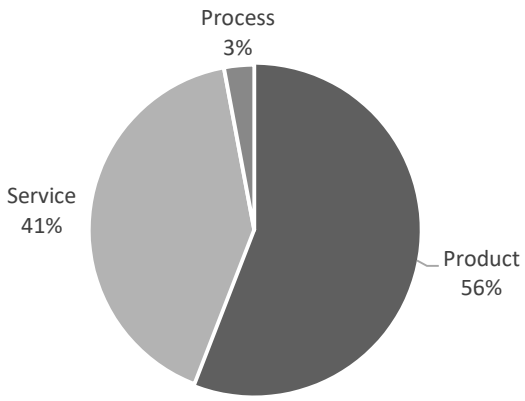


Fig. 4 Sector of application

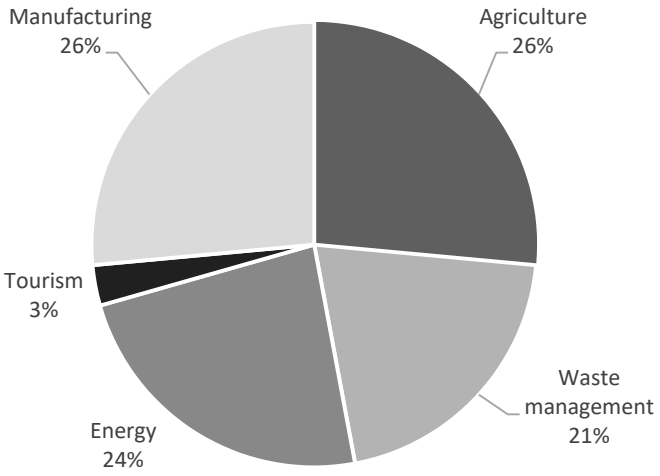


Fig. 5 Percentage breakdown of geographical areas considered in the case studies

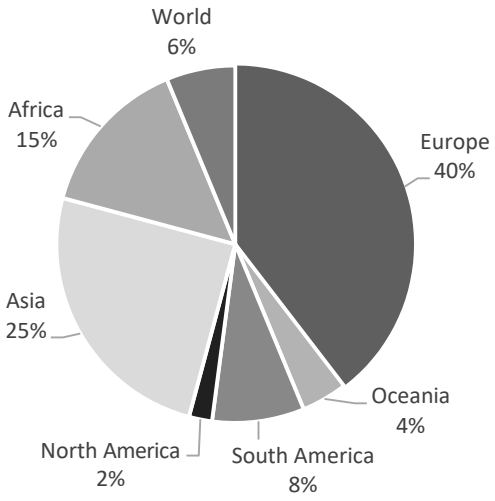
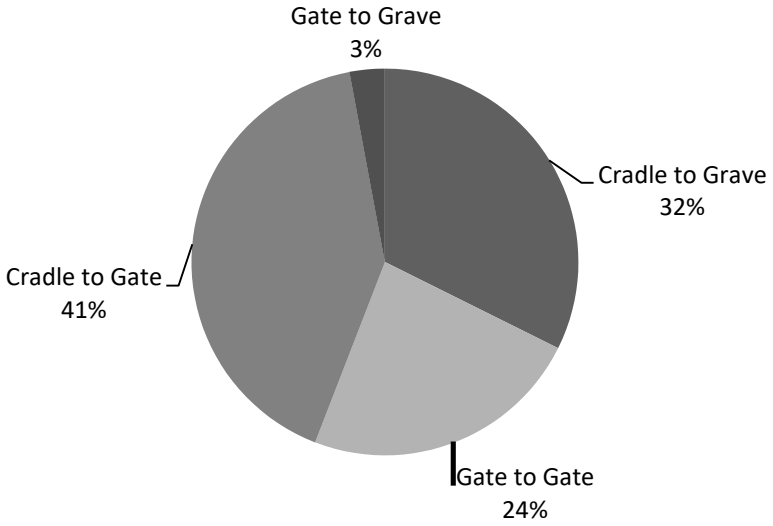


Fig. 6– Breakdown of SB detected in case studies analyzed



Tables

Table 1 SLCA case studies reviewed

Albrecht et al.	2013	An extended life cycle analysis of packaging systems for fruit and vegetable transport in Europe
Aparcana and Salhofer	2013a	Development of a social impact assessment methodology for recycling systems in low-income countries
Aparcana and Salhofer	2013b	Application of a methodology for the social life cycle assessment of recycling systems in low income countries: three Peruvian case studies
Arcese et al.	2013	Social Life Cycle Assessment as a Management Tool: Methodology for Application in Tourism
Baumann et al.	2013	Does the Production of an Airbag Injure more People than the Airbag Saves in Traffic? Opting for an Empirically Based Approach to Social Life Cycle Assessment
Bouzid and Padilla	2014	Analysis of social performance of the industrial tomatoes food chain in Algeria
Chang et al.	2015	Environmental and Social Life Cycle Assessment of welding technologies
Ciroth and Franze	2011	LCA of an Ecolabeled Notebook. Consideration of Social and Environmental Impacts Along the Entire Life Cycle
De Luca et al.	2015	Social Life Cycle Assessment and Participatory Approaches: A Methodological Proposal Applied to Citrus Farming in Southern Italy
Ekener-Petersen and Finnveden	2013	Potential hotspots identified by social LCA—part 1: a case study of a laptop computer
Ekener-Petersen and Moberg	2013	Potential hotspots identified by social LCA–Part 2: Reflections on a study of a complex product
Ekener-Petersen et al.	2014	Screening potential social impacts of fossil fuels and biofuels for vehicles
Feschet et al.	2013	Social impact assessment in LCA using the Preston pathway - The case of banana industry in Cameroon
Foolmaun and Ramjeeawon	2013a	Comparative life cycle assessment and social life cycle assessment of used polyethylene terephthalate (PET) bottles in Mauritius
Foolmaun and Ramjeeawon	2013b	Life cycle sustainability assessments (LCSA) of four disposal scenarios for used polyethylene terephthalate (PET) bottles in Mauritius
Franze and Ciroth	2011	A comparison of cut roses from Ecuador and the Netherlands
Hosseinijou et al.	2014	Social life cycle assessment for material selection: a case study of building materials
Hu et al.	2013	An approach to LCSA: the case of concrete recycling

Lemhann et al.	2013	Social aspects for sustainability assessment of technologies—challenges for social life cycle assessment (SLCA)
Luthe et al.	2013	A Systems Approach to Sustainable Technical Product Design - Combining Life Cycle Assessment and Virtual Development in the Case of Skis
Macombe et al.	2013	Social life cycle assessment of biodiesel production at three levels: a literature review and development needs
Manik et al.	2013	Social life cycle assessment of palm oil biodiesel: a case study in Jambi Province of Indonesia
Martínez-Blanco et al.	2014	Application challenges for the social Life Cycle Assessment of fertilizers within life cycle sustainability assessment
Moriizumi et al.	2010	Simplified life cycle sustainability assessment of mangrove management: a case of plantation on wastelands in Thailand
Nemarumane et al.	2015	Social Life Cycle Assessment in the South African Sugar Industry: Issue and Views
Ren et al.	2015	Prioritization of bioethanol production pathways in China based on life cycle sustainability assessment and multi criteria decision-making
Revéret at al.	2015	Socioeconomic LCA of Milk Production in Canada
Rugani et al.	2014	Towards prospective life cycle sustainability analysis: exploring complementarities between social and environmental life cycle assessments for the case of Luxembourg's energy system
Traverso et al.	2012	Towards life cycle sustainability assessment: an implementation to photovoltaic modules
Umair et al.	2015	Social impact assessment of informal recycling of electronic ICT waste in Pakistan using UNEP SETAC guidelines
Valdivia et al.	2012	A UNEP/SETAC approach towards a life cycle sustainability assessment—our contribution to Rio+20
Vinyes et al.	2013	Application of LCSA to used cooking oil waste management
Weldegiorgis and Franks	2014	Social dimensions of energy supply alternatives in steelmaking: comparison of biomass and coal production scenarios in Australia
Wilhelm et al.	2015	An overview of social impacts and their corresponding improvement implications: a mobile phone case study
Yu and Halog	2015	Solar Photovoltaic Development in Australia—A Life Cycle Sustainability Assessment Study

Table 2 Inclusion/exclusion criteria used developing systematic review

INCLUSION CRITERIA	EXCLUSION CRITERIA
SLCA methodology	Secondary studies
Study published between January 2009 to May 2015	Duplicates studies
Primary studies	Non-English written papers
	Domain-specific papers
	Grey literature
	Redundant paper of same author

Table 3 Keywords used in the research and results obtained

			Google Scholar	Scopus	Discovery Service
"Social Life Cycle Assessment"	**AND**	**case study**	862	23	428
"Social Life Cycle Assessment"	**OR**	**case study**	920	1,281,455	16,498,477
Social Life Cycle Assessment	**AND**	**case study**	17600	278	487,847
Social Life Cycle Assessment	**OR**	**case study**	17600	1,282,529	16,561,218
"Social LCA"	**AND**	**case study**	544	10	252
"Social LCA"	**OR**	**case study**	587	1,281,427	16,498,416
Social LCA	**AND**	**case study**	18200	149	19,840
Social LCA	**OR**	**case study**	19900	1,281,943	16,503,106
"Societal LCA "	**AND**	**case study**	136	1	65
"Societal LCA "	**OR**	**case study**	138	1,281,395	16,498,293
Societal LCA	**AND**	**case study**	8140	17	6,172
Societal LCA	**OR**	**case study**	8510	1,281,442	16,498,680
"Societal Life Cycle Assessment "	**AND**	**case study**	53	2	49
"Societal Life Cycle Assessment "	**OR**	**case study**	52	1,281,397	16,498,297
Societal Life Cycle Assessment	**AND**	**case study**	21300	35	145,270
Societal Life Cycle	**OR**	**case study**	24400	1,281,523	16,504,121

			Google Scholar	Scopus	Discovery Service
Assessment					
SLCA	**AND**	**case study**	17600	19	1,066
SLCA	**OR**	**case study**	1790	1,281,539	16,499,972