Social Life Cycle Assessments

Subjects: Social Issues
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Society's interest in social impacts of products, services and organizational behaviors is rapidly growing. While life cycle assessments to evaluate environmental stressors have generally been well established in many industries, approaches to evaluate social impacts such as Social Life Cycle Assessment (S-LCA) lack methodological consistency and standardization. The aim of this paper is to identify past developments and methodological barriers of S-LCA and to summarize how the automotive industry contributed to the advancement or application of this method.

Keywords: Social Life Cycle Assessment ; literature review ; social sustainability ; Sustainable Development Goals ; automotive industry ; S-LCA

1. Introduction

S-LCA is the youngest and least mature method. Despite guiding documents such as the Guidelines for Social Life Cycle Assessment of Products developed by the United Nations Environment Programme (UNEP) and the Society of Environmental Toxicology and Chemistry (SETAC) (hereafter called Guidelines) [1], the UNEP/SETAC methodological sheets for sub-categories in S-LCA [2] or the Handbook for Product Social Impact Assessments (PSIA) [3], S-LCA studies differ greatly and are often criticized because inconsistencies and contradictions in methodological components impede the generation of transparent, reliable and comparable results [4][5]. Another issue is that the S-LCA method remains isolated from social sustainability targets such as the SDGs. As a result, S-LCA is often considered a challenging assessment with comparatively little application in many sectors such as the automotive industry.

The lack of applicability of S-LCA does not just impede the merger of all three methods into LCSA but it also leaves an entire dimension in the dark. The automotive sector in particular has enormous potential to improve social impacts, because its large and complex network creates employment and prosperity in societies around the world [6]. A structured and standardized S-LCA procedure would help decision-makers to understand and compare the social value of companies such as automotive producers, reveal the potential shift of stressors between dimensions and enable well-informed decisions that reduce the risk of unintentional social harms, while increasing the benefits caused by corporate activities and products. In order to reveal future research potential in general, and with a focus on the automotive industry, this paper has the objective to display the status quo of S-LCA based on three research questions: (1) How did S-LCA research develop over time? (2) To what extent are UN SDGs an integral part of S-LCA research? (3) How and to what extent has S-LCA been used by the automotive industry? (4) What barriers exist and need to be overcome in future research?

The difference between this paper and past publications is that most literature reviews allow a deep dive into a certain issue of S-LCA without presenting the big picture. For instance, Sureau et al. [7] distinguished between classification methods of social impact pathway approaches through the analysis of characterization models translating correlations or causality. Russo Garrido et al. [8] followed a similar path by exploring applied categorization and weighting methods. Others broadened the understanding of approaches used to create the product system and cut-off criteria for S-LCA [9] or discuss epistemological challenges linked to cut-off criteria, system boundaries or Areas of Protection (AoP) [10]. Review papers are also used to understand the applicability of S-LCA, such as that of Thorstensen and Forsberg [11], who searched for reasons why and how S-LCA could be helpful for responsible research and innovation, or Lucchetti et al. [12] who analyzed which sectors performed case studies in the past. From an automotive angle, the focal point of literature reviews was on the selection of appropriate impact indicators or the potential merger of the three methods into LCSA [13] [14]. Only a few recently published review papers have had the goal to provide a general picture of S-LCA including barriers and future research potential. Di Cesare et al. [15], for instance, analyzed the state of the art and potential to incorporate positive impacts in S-LCA, while Huarachi et al. [16] summarized the historical evolution of S-LCA through the development of phases that S-LCA has gone through [15][16]. The present paper goes further and combines phases with political and scientific milestones in one timeline to visualize all influences that shaped S-LCA in the past. Another novelty is the assessment of how SDGs are currently integrated in S-LCA and the overview of to what extent the automotive industry participated in advancing this method. As a result, this review helps researchers and readers new to this subject to understand the status quo of S-LCA and future research potential at both the scientific and corporate levels. This study can also serve as a stimulus for other industries outside the automotive sector.

2. Data Acquisition and Evaluation

The systematic literature review was based on bibliographic databases and electronic libraries of major publishers such as Web of Knowledge [17], the German National Library [18], ScienceDirect [19], Springer Professional [20] and Wiley [21]. Since Khabsa and Giles [22] estimated that the search engine Google Scholar contains approximately 87% of all published academic documents written in English language, it was used as well. Before the actual literature review, four research questions as well as inclusion and exclusion criteria were defined to guide the structured search. In order to analyze the latest S-LCA literature, the reviewed time span was limited to the period from 2015 until November 2020 and focused on literature written in German or English. In addition, studies were included if they are publically available and address at least one of the following aspects: past developments of S-LCA, the connection between SDGs and S-LCA, the participation of the automotive industry, methodological barriers of S-LCA. In contrast, studies were excluded from the literature review if S-LCA was an acronym for other methods such as simplified life cycle analysis, screening life cycle analysis, static life cycle analysis, and streamlined life cycle analysis. Another exclusion factor was if the research was focusing on the environmental or economic dimension of sustainability or if the social dimension was assessed with other methods than S-LCA, such as social supply chain assessments. The following search strings and keyword combinations of different terminologies and abbreviations commonly used for Social Life Cycle Assessments were used and combined in the search fields and title: “Social LCA”, “S-LCA”, “SLCA”, “Social-Life-Cycle-Assessment” , “Social Life Cycle Assessment”, “social impact assessment”, “social life cycle impact assessment”, “SLCIA”, “S-LCIA”, “Socio-economic Life Cycle Assessment”, “Societal Life Cycle Assessment”, “Societal-Life-Cycle-Assessment” , “Social Footprint”, “Social Sustainability Assessment”.

The data evaluation was based on two instruments. On the one hand, all basic parameters were elaborated in an MS Excel spreadsheet. Those include the author names, title, year and type of publication (e.g., journal article, conference paper, book chapter). It further includes the categorization of all publications into the following three groups, inspired by Tarne et al. [14]: (a) analytical studies, which denote publications that either develop a new method/framework or advance an existing one; (b) theoretical studies, which include literature reviews and papers discussing underlying theories or epistemological positions; and (c) empirical studies such as case studies. The classification (d) analytical + empirical is used for publications that propose new or advanced methods tested in the author’s own case studies. Other columns list whether or not the studies follow the UNEP/SETAC Guidelines and methodological sheets or how SDGs and positive impacts are integrated in the assessment. In the context of S-LCA, social impacts are linked to stakeholder categories, meaning sub-groups of the society that are affected by organizations and products. For each stakeholder category, UNEP/SETAC and PSIA define impact categories, which are the social issues affecting the respective stakeholder, e.g., human rights influencing workers [23]. In S-LCA different socially significant matters are generally clustered within so-called impact categories such as human rights. Within these categories, sub-categories of more detailed matters such as forced labor or child labor are aggregated [23]. At the end, input for every sub-category is gathered through indicators and inventory data [23][24]. In order to detect which stakeholders and impact sub-categories have been assessed, a second spreadsheet compiles this information for all case studies.

On the other hand, a qualitative content analysis was used to detect milestones in S-LCA history, current methodological barriers, the connection between SDGs and S-LCA and the role of the automotive industry in S-LCA research. Therefore, qualitative data gathered from the portfolio were evaluated according to Kuckartz’s [25] computer-based qualitative content analysis using MaxQDA Software. A qualitative content analysis is an approach of systematic and rule guided qualitative analysis applicable to text documents, pictures or videos [26]. This method is advantageous when dealing with large amounts of data, because it narrows down the wealth of information to such an extent that only relevant data remain [25] [26]; relevant is every piece of information that helps answer the research questions. In the context of this review, data are relevant if they provide information on: past development of S-LCA, the connection between SDGs and S-LCA, the participation of the automotive industry or methodological barriers. The content analysis follows five consecutive but interconnected steps, beginning with the textual work, which describes the first contact with the material [25]. This step comprises the development of the literature portfolio as outlined above. In a second step, content specific codes are defined with the purpose of gathering all information provided to a specific topic. These pre-defining (deductive) codes, such as stakeholder categories and impact categories proposed by UNEP/SETAC, rely on theoretical knowledge and help to gather information from all articles regarding a specific topic [26]. Once the deductive coding scheme is established, it is applied to the material by sorting all relevant passages into the codes. Working with qualitative data frequently requires a coding closely linked to the material, which is why the sorting process also induces inductive codes on information given in the material [26]. Examples are methodological barriers named and discussed in the literature. Coding all text passages has the effect that information is clustered according to its content and researchers are able to extract the essence and, thus, answer the research questions. The final codebook is used for a second examination of materials, to ensure that all relevant text passages are coded correctly. QDA software facilitates the coding process because it enables the structured procedure even if more than one researcher is involved and, thus, reduces researcher bias while yielding reproducible results. After the final coding process, the data are ready to be evaluated. This includes a descriptive presentation and final evaluation of contents as presented hereafter [25].

3. Results and Discussion

The findings from the literature review imply that the automotive industry understands the potential benefits of S-LCA, but also that the research in this field is very fragmented. During the last eight years from 2013 to 2020, only ten studies have been detected as automotive S-LCAs (see Table S3 of the Supplementary Material). Those studies cover mostly vehicle components, such as airbags [35] or catalysts [45], instead of entire vehicles and assess a restricted number of stakeholder categories and impact (sub-)categories. The analysis further highlights that services provided by this sector have never been assessed, despite their relevance when aiming for an accurate description of potential positive and negative social impacts of products and companies. Besides a general contribution to the development of S-LCA methods, integrating the SDGs into automotive industry-specific S-LCA offers new research potential, because the SDGs have been ignored in all the above-mentioned studies. Additionally, the testing of the revised Guidelines (2020) would be valuable, because seven out of ten studies applied procedures recommended by the first UNEP/SETAC Guidelines for their assessment. Another interesting field is the consideration of positive impacts, which has only been part of three out of ten automotive industry-related studies discovered in this review, as well as the applicability of S-LCA to services.

The procedural phases of S-LCA are based on the ISO 14040/44 framework on Life Cycle Analysis in Environmental Management and consist of four consecutive but interrelated steps: the goal and scope definition, inventory analysis, the impact assessment and interpretation [25]. In the content analysis, information on methodological barriers has been gathered within individual inductive, content-specific codes. Therefore, information of different publications regarding methodological barriers is listed in the codes, which accumulate the essence of each barrier. As a result, the following five barriers have been detected: (1) linking LCA structures to social phenomena, (2) unclear underlying theory and epistemological positions, (3) process vs. organizational S-LCA, (4) missing link between SDGs and S-LCA impact sub-categories, (5) defining and integrating positive impacts, (6) generic vs. site-specific data and the dependency on stakeholder participation, (7) tracking social impact pathways, (8) neglected stakeholder categories and the variety of impact sub-categories, (9) lacking comparability and transparency of S-LCA.

In sum, S-LCA is full of uncertainties and lacks transparency because of the number and variety of approaches affecting the selection of impact categories, indicators, stakeholder categories, characterization, normalization and interpretation of data. Although a standardization would guide S-LCA towards becoming an more easily applicable tool, the previously discussed barriers such as the difficulty to develop a universal set of indicators that covers social aspects in all social, economic and political contexts impedes such standardization.

4. Conclusions

The aim of this literature review was to provide a big picture of past developments and the current situation of S-LCA. Elaborating on the historical phases, milestones and Advances of S-LCA set the scene for a detailed analysis of methodological barriers and inconsistencies. It shows that even 25 years after the first appearance of social impact assessments, S-LCA is still a young and immature method, especially when compared to E-LCA. ISO norms standardize the procedure of E-LCA and databases such as GaBi and ecoinvent help to calculate comprehensible and comparable impact assessments [27][28]. In S-LCA, such structures are still missing because the complicated testing and verification of social impact pathways and the facets of social issues that connect to many different disciplines and theories make it even more complicated to define one universal standard. In fact, scientists even struggle to agree on methodological elements such as impact categories and keep adjusting methods according to particular purposes. As a consequence, S-LCA results are often uncertain and lack transparency and reproducibility.

A major challenge is the interpretation of S-LCA results when it comes to internationally agreed social targets such as the SDGs. The literature review shows not only that SDGs are insufficiently included in S-LCA, but also that the definition of SDG targets impedes such inclusion. As a result, S-LCA is far from being a standardized and easily applicable tool and requires large amounts of in-depth knowledge and time.

In recent years, more and more industries such as the automotive industry have engaged in the testing and development of S-LCA. As one of the most influential sectors in Europe, the automotive industry could benefit from the display of social impacts of products and services. S-LCA and the transparent portrayal of methodological procedures, decisions and results offers a competitive advantage and could drive the transition towards a sustainable company or sector.

Future research on the integration of SDGs at the indicator level of S-LCA could offer a benchmark for individual performance interpretations and corporate contributions to the achievement of SDGs. Additional research on the combination and display of positive and negative impacts is needed to move away from the sheer risk assessment and to make S-LCA a tool that guides companies towards positive social contributions through their businesses. Therefore, the comprehensible display of methodological choices and decisions and the application of S-LCA in case studies is needed to make S-LCA applicable to all sectors—including service providers—and to test inventory assessment methods. In this way, it would be possible to evaluate whether or not a standardization on a sector level through, e.g., sector-specific sets of impact sub-categories, is possible. In addition, advancing databases is essential to promote the applicability and usage of S-LCA in a more consistent and transparent way. Only if the clear calculation and interpretation of S-LCA is possible will a combination with other in LCSA (E-LCA, S-LCA and LCC) be possible. In particular, the S-LCA methodology has to be

developed further to reach the current extension and status of alignment which E-LCA has already reached. Once the individual methods have been developed, the results for the individual impact categories need to be aggregated. Similar to weighting approaches (which are an optional part within the impact assessment of E-LCAs), methods can be further developed for S-LCA as well as LCSA to enable a communication of results to non-sustainability-experts by single- or multi-score values.

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