

## **Social-Life-Cycle Assessment (S-LCA): an instrument for macro-ergonomics in a globalized world?**

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**Abstract.** This paper deals with the ergonomic relevance of the Social-Life-Cycle Assessment of Products (S-LCA) which was initially developed by the United Environment Programme in 2009. The S-LCA identifies social issues with an impact on stakeholders along the total life-cycle of a product. In a globalized world life-cycle aspects concerning working conditions are of growing importance. The framework and the process of the S-LCA will be discussed and first ideas linking the S-LCA with a life-cycle oriented work systems analysis will be introduced.

**Keywords.** Social-Life-Cycle Assessment, S-LCA, social impact, Stakeholder, Life-cycle.

### **1. Why life-cycle assessments?**

In a globalized world there is a growing need to take more responsibility for the entire value creation chain of a product. In Europe, for example, the discussion focused on corporate social responsibility is part of the European Union's policy related to all aspects of sustainability. This leads to companies becoming interested, for example, in the working conditions in their supply chain. Special attention is given to see if the supply chain includes companies in countries where social standards are significantly different from those in Western countries. Not solely the working conditions during the production or assembly are of interest in this context, but also the work systems during the entire life-cycle of the product: from extraction of raw materials to the recycling or re-use of the product. All of the above points raise the question as to which instruments are available and how they can be used to answer ergonomics questions. The paper focuses on the social dimension of the triple-bottom line approach (GfA 1999) of the discipline of human factors and ergonomics. Apart from social topics, aspects of the economic and ecological dimensions must also be integrated into a comprehensive ergonomics life-cycle approach.

### **2. The Social-Life-Cycle Assessment framework and process**

The S-LCA was developed in 2009 by the United Nations Environment Programme (UNEP) with the intention of integrating social impacts into the decision-making process for technologies and products. This integration can also support the sustainable development. (UNEP 2009)

The S-LCA deals with social impacts along the entire life-cycle of those products that have an effect on stakeholders. Within the value creation chain the use phase is also part

of the product life-cycle (UNEP 2009). The UNEP guidelines use the stakeholder definition according to Freeman. He defines stakeholders as a group or individuals who affect the achievement of the corporate goals or are affected by the achievement of those goals (Freeman 2010). In the following, the S-LCA will be described on the basis of the guidelines developed by the UNEP.

The UNEP-guidelines recommend the classification of life-cycle phases into extraction of raw materials, design and production, packaging and distribution, use and maintenance and disposal. Within the life-cycle phases, the characteristics of the location where the process takes place must be considered. The S-LCA contains four steps: goal and scope definition, inventory analysis, impact assessment and interpretation. The framework of the S-LCA is based on the framework of the environmental life-cycle assessment (E-LCA). (UNEP 2009) Figure 1 illustrates the four phases of the S-LCA.

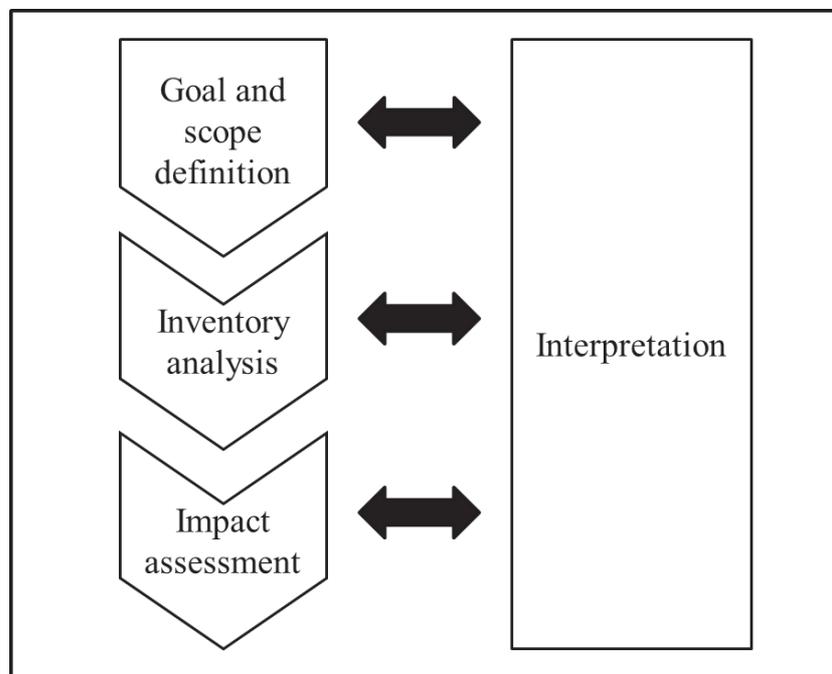


Figure 2 Phases of an S-LCA (DIN EN ISO 14040)

Subcategories have been created for the specific measurement of social topics. A subcategory is defined as a socially significant topic or property such as forced or child labour, for example. The subcategories consist of study specific social and socio-economic indicators. After selecting the subcategories they must be assigned to stakeholders and impact categories. One impact category, for example, is that of labour rights. The guidelines recommend the classification into these five stakeholder groups: workers, consumers, local community, society and value chain actors. It will be necessary to check the usefulness of an adaptation of these categories. The impact categories ought to be selected according to international standards e.g. the UN agreement concerning economic, social and cultural rights, the Economic and Social Council “ECOSOC”. (UNEP 2009)

The “Goal and scope” consists of two steps: First, a clearly stated goal of the study has to be formulated. Within the goal definition the intended purpose of the study must be formulated. The guidelines describe the identification of social hotspots or the identification of negative impacts as possible goals of an S-LCA (UNEP 2009). Based on

the goal(s), the concept of the study will be deployed. The study scope needs to be defined depending on the goal definition. To allow the comparison between different production and work systems alternatives, respectively, the results must be standardized. In this S-LCA phase the “depth” of the study is defined. Additionally, the type of data used for the multiple process steps must be defined as well. The integration of stakeholders into the implementation process of the study is also suggested. The scope of an S-LCA depends on the width and depth of the study. In this context it is necessary to specify the detail level of the information and to define the investigated life-cycle phases. One task is the description of the product system. The product system is the collection of elementary and product flows, performing one or more defined functions (DIN EN ISO 14040). Production and organizational related aspects are part of the product system (UNEP 2009). On this basis a decision concerning the data selection is taken. The system boundaries must be clearly determined and it must be defined, which processes will be investigated and which ones are out of scope. By considering these constraints, the system under examination will be fixed. If process steps will be out of scope, the reason must be documented. If the collection of specific data is resource intensive, it might be advisable to substitute the specific data by generic data and enable an approximate alternative. (UNEP 2009)

The phase “inventory analysis” focuses on activities geared towards data collection. In particular, data must be gathered on the previously defined process units and social hotspots related to the product system. The first part of this phase is characterized by the iterative refinement of the system boundaries based on initial screening activities and descriptive data on the investigated processes, e.g. the number of working hours. The UNEP guidelines recommend the modelling of a cost efficient system which enables an evaluation from afar. The analysis could also be supplemented by activities on-site. On-site activities are not in all cases possible, however, since they might well be resource intensive. A first step of the data collection consists in the clarification of the geographic location of the process units and the identification of all the organizations involved. The second step describes and pinpoints the social hotspots along the life-cycle while the third step is the determination of subcategories. Following that, a data collection strategy can be developed containing details about generic and specific data. To guarantee the reliability and validity of the study a high level of quality and completeness of the collected data is obligatory. (UNEP 2009)

During the phase of “impact assessment”, at first indicator data are accumulated to form subcategory results. Then a classification according to impact categories is made. To do so, aggregation methods and impact categories must be selected. The selection of the subcategories, impact categories and methods depends on the goal definition which is part of the phase “goal and scope”. The selected methods must take the particularities of the data specifications into consideration. Qualitative as well as (semi)quantitative data could be part of an S-LCA. (UNEP 2009)

The Goal of the S-LCA’s fourth phase, “interpretation”, is to identify socially significant issues. During this phase, a consistency and completeness check is necessary. In order to increase the validity of the S-LCA study, the identified social impacts ought to be linked to affected stakeholders who in turn should take an active role in the conduction of the study. Part of the interpretation phase is the evaluation of the participation level of stakeholders. Conclusions, recommendations and reports are part of this phase. To guarantee an easy overview, the S-LCA guidelines recommend an objective-oriented solution interpretation. One possibility to cluster the results is the categorization into data-

classes (generic and specific). Another possible categorization is clustering the results according to analytic classes, e.g. certainty of results. (UNEP 2009)

### 3. Ergonomic relevance of the S-LCA

The need for a systematic analysis, arrangement and design of technical, organizational and social conditions of working processes is an integral part of common ergonomic definitions (Schlick et al. 2010). According to a definition of the German Human Factors and Ergonomics Society: „Ergonomics (or human factors) integrates social, economic and ecological objectives”. (GfA 1999) The S-LCA addresses the social dimension of the triple-bottom line approach. To ensure a holistic solution, these topics must be considered along the total life-cycle of a product (Zink 2014). In 2013, Bruder, as president of the German Human Factors and Ergonomics Society, additionally identified the need for the ergonomic community to take a multidimensional responsibility for the design of working systems. Besides the realization of economic goals it is also important to guarantee the responsibility for ethical topics and human rights. A sustainable business model must therefore ensure economic results as well as human well-being, safety and health. (Bruder 2013)

A sustainable business model has to be based on the concept of “sustainable development” which includes two main issues: while on the one hand, the three dimensions of ecology, economy and social impacts must be equally considered, on the other hand the intra- and intergenerational justice must be taken into account. The intra-generational justice regulates the fair relations within today’s generation; particularly between industrialized and industrially developing countries. The inter-generational justice regulates the fairness between today’s and future generations (von Hauff 2012).

In 2011, the European Commission re-formulated and introduced its strategy for social responsibility of companies (Corporate Social Responsibility). Companies can contribute to the realization of the EU-goal “sustainable development” by applying CSR. To meet social responsibility, the EU demands of companies to apply a technique integrating social, ecological and ethical issues related to human rights and consumer demands. In addition, the inclusion of stakeholders is demanded. Hereby, mutual attitudes of shareholders and further stakeholders of the company will be intended. Additional negative impacts that could not be avoided will become transparent. (Europäische Kommission 2011)

Increasingly, the discussion related to sustainable development in management science also considers the social dimension of sustainability, which focuses the social coherence of humanity, freedom and justice. In the past, the other two dimensions – ecology and economy – have been in the foreground. To guarantee the future viability of a society it has become necessary to weight the social dimension with the same emphasis as the other two. (von Hauff 2012)

In 2012, Dul et al. published a paper regarding the further development of the human factors and ergonomics discipline (HFE) initiated by the board of the International Ergonomics Association. One recommendation of this strategic paper is to increase the range of instruments for decision makers on the grounds that they have a high influence on work systems and products. As a precondition HFE has to increase the attention of top decision makers concerning the instruments of the HFE discipline. In this context, current

instruments must be refined and further developments are necessary. (Dul et al. 2012) The S-LCA could be such an instrument relevant for top management too.

As many corporate websites include descriptions of sustainability and responsibility one might presume the significance of that topic to those companies – unless it is only a public relations issue. If companies are dealing seriously with these topics, however, one can question whether these companies indeed have the respective methods and tools to deal with the challenges related to social impacts along the complete life-cycle. The S-LCA provides a framework and delineates a process as to how social impacts can be integrated into a life-cycle- oriented analysis of working systems. Furthermore, economic and ecological aspects of the triple-bottom line approach of the discipline of human factors and ergonomics must be integrated into an ergonomic life-cycle approach.

#### 4. Discussion and Conclusion

While also taking other classes of requirements into account, the theory of integrated product development focuses on human, societal and environmental requirement classes. This infers that ergonomic requirements are part of the integrated product development. (Ehrlenspiel 2009) The S-LCA offers a framework tailored to enable a systematic consideration of ergonomic topics not only during the product development phase but also along the entire life-cycle of a product and its work systems. In order to use the S-LCA for holistic ergonomic assessment it will have to be compared to existing ergonomic instruments. This might make an adaptation necessary. It could also be the basis for a life-cycle oriented product and work systems management. As a prerequisite, methodological considerations of ergonomic impacts along the complete life-cycle of a product must be taken into account. This additional development is consistent with the identified research needs by Jörgensen in 2012, for example. He recommends a further development of the S-LCA to enable an effective integration into corporate decision processes. (Jörgensen 2012) In further contributions it will become necessary to clarify how the S-LCA integration into the product and work systems management of organizations can be designed in relationship to all necessary ergonomic instruments.

Considering that ergonomics is concerned with the overall system's performance and people's well-being, a Social Life-Cycle Perspective on its own is not sufficient. To obtain a holistic solution in the sense of the three pillar model of sustainability, an economic and ecological Life-Cycle Analysis has to be done additionally. As these other instruments are much more well-known than the Social Life-Cycle Assessment the topic of clarifying S-LCA has been dealt with here.

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