10th Conference on Engineering Education for Sustainable Development (EESD2020)

A tool for introducing Social Life Cycle Assessment of products and feedback from its users.

Tatiana V. Vakhitova[1], Mike F. Ashby[2]

ANSYS Granta, Academic Relations Team

tatiana.vakhitova@ansys.com

Abstract

Product design involves the choice of materials, the processes used to shape them, transport modes, characteristics of the way the product is used and of its disposal at end of life. All of these influence the environmental impact of product life, now much studied using sophisticated (environmental) life-cycle assessment (E-LCA) tools. They also have social impacts that can be negative or positive contribute to either negative or positive social and environmental impact. The study of these is much more recent, stimulated initially by the UNEP / SETAC "Guidelines for Social Life Cycle Assessment (S-LCA) of Products" (UNEP/SETAC Guidelines) of 2009, and now gathering traction across the LCA community.

We have developed an Excel-based Social Impact Audit Tool (the Tool) following the UNEP / SETAC guidelines. Its primary aim is one of education, introducing students to the UNEP / SETAC methodology, providing data about social norms and practices in the Nations of the world, and allowing case studies for activity-based learning. The Tool flags social hotspots, highlighting the points in the life of a product at which potential harmful practices or opportunities to enhance well-being exist. The Tool is accompanied by a White Paper explaining its use and providing examples of its use. In a real world this type of analytics can be used, for instance, for CSR strategies on how to improve local conditions in locations in which a company operates.

The paper describes feedback from trialling the Tool at several universities, reporting on the expected and received learning outcomes; the ease of use and the clarity of the information provided; and how well the expectations were met.

1 Sustainable Development and Life Cycle Assessment

The UN report of 2015, “Transforming our World”, introduced a set of Sustainable Development Goals to be achieved by 2030. It was supported by governments around the world. With 10 years to go, many of those goals will be missed. It is estimated that 430 million people will remain in extreme poverty by 2030 (Editorial, 2020), even though eliminating this was one of the goals. Similar failures are foreseen in meeting social and environmental goals. There are calls for greater focus on interlinkages of the goals and their synergies, instead of trade-offs among them (Kroll *et al*, 2019). Moreover, fit-for-purpose tools and mechanisms are required to encourage the gathering and monitoring of this kind of data (Ibid.).

Today’s more established tools mainly focus on environmental impact assessment, such as LCAs, whereas social impacts are not well assessed and, therefore, synergies are not well-established (see Figure 1).

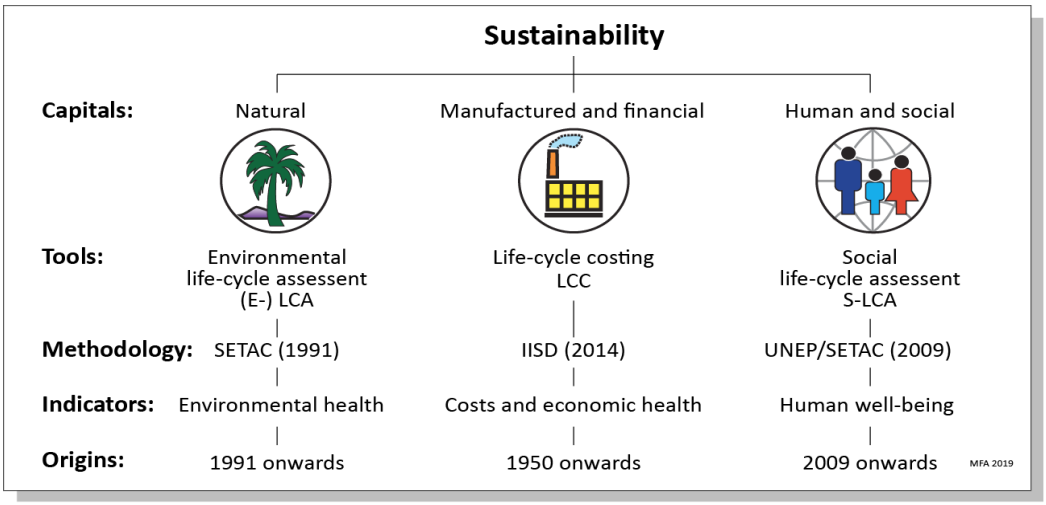

Figure 1. Life Cycle Assessment (LCA), Life Cycle Costing (LCC) and Social Life Cycle Assessment (S-LCA) (Ashby et al: 2019, 4).

Social life-cycle assessment (SLCA) has its roots in the Guidelines formulated in an UNEP/SETAC report over 10 years ago. It is currently undergoing revision under the UN Environment Life Cycle Initiative supported by the SLC Alliance to facilitate emerged diverse practices and applications with a more robust framework and guidance (Life Cycle Initiative 2020). Moreover, there is an identified industrial need for a reliable tool and accompanying data for integrating Sustainability in a Life Cycle Assessment process, which aids exploration of potential synergies among all pillars of sustainable development (Ibid).

However, a recent survey among educators involved in teaching sustainable development to engineers, designers and scientists at undergraduate and graduate level, with more than 200 respondents, showed that less than 30% address social impact in some form in their teaching (Vakhitova *et al*, 2015).

2 The Social Impact Audit Tool

The Social Impact Audit Tool (the Tool) (its detailed description is available in Ashby *et al*, 2019) is an attempt to support teaching of social impact during product life. The mission of the Tool is to provide a simple and visual overview of Social Hotspots in countries, where a product (or the material(s) from which it is made) has been produced, used or disposed. A Social Hotspot is identified as a "point of contact between stakeholders and aspects of the materials, manufacture, distribution and use of the product that may, potentially, be damaging or could be influenced in a positive way" (Ibid., 14). The Tool was trialled with students and faculty members, receiving positive feedback (see section 3).

The Tool is implemented in Excel, following the steps of UNEP/SETAC Guidelines for S-LCA, which parallels that established for Environmental LCA. It contains social and economic data for 205 countries, drawn from publicly available sources. Applying a threshold level of "good practice" reveals the countries and impact categories that fall below the threshold, acting as an indicator for further analysis. The tool provides a snapshot of potential social hotspots associated with the life of a product, but is limited to analysis at a National level, giving no insight into practice and the level of a specific enterprise.

From and educational perspective, the Tool provides an introduction to social life cycle assessment and as a gateway to further discussion about wider facets of sustainable development, analysis of Corporate Social Responsibility strategies and social investments. Ultimately the identified Social Hotspots could be used for directions of positive change for a product producing company, benefiting from access to human and environmental resources in countries of operations.

3 Feedback from trialling courses

The Tool was trialled in two universities in the USA during the last quarter of 2019: University of San Diego and PennState College of Engineering. On completion, the lecturers provided information on the following points:

- reactions of users on the value of the Tool,
- ease of use and clarity of the information provided to users, and
- changes or additional resources, which make it easier to introduce S-LCA to students.

At the University of San Diego, Dr Laura Gelles and Susan Lord incorporated the Tool into a Material Science course of a newly formed Department of Integrated Engineering, typically taken by engineering students. The Tool was introduced in a one-hour lecture plus a home assignment (~3 hours). A final assignment was used to assess the students' grasp of key ideas.

The learning objectives assigned to the course included: reflexion on environmental, economic, and social impacts when selecting a material and possible "recommendation for change of material and/or change of country of material origin, production, or end of life based upon the Social Impact Audit tool". The case study based around the use of a polypropylene drinking straws was used for analysis, suggesting alternatives such as paper, stainless steel, and bamboo. These provide triggers to unlock creativity and to stimulate development of strategies to reduce both the environmental and the social impact of their use, using the S-LCA tool as resource to support the second of these.

Professor Thomas Litzinger from the Institutes of Energy and the Environment (IEE) and Leonhard Center for the Enhancement of Engineering Education (USA) used a slightly modified version of the S-LCA tool in a workshop format. The modification combined the original data with "best/worst" actual values for the USA for impact category. Two one-hour workshops were performed. One with a group of top students and another one with a number of faculty members responsible for ABET-accreditation processes. Each workshop had contained a 15 min talk on Social Impact Audit Tool, following an introduction to an LCA and Social LCA. No explicit learning outcomes were set (it was a one-off exercise) but feedback was sought on the following questions:

- ease of use,
- perceived value (is it worth the time?),
- the case for including S-LCA studies in all Engineering and Computer Science programs, and
- the extent of learning about Social issues in other engineering courses in their program,
- if the Tool would be useful for meeting the new ABET "student outcomes", in particular, "the impact of engineering solutions in global, economic, environmental, and societal contexts" (2019, 3.4 and also in 3.2).

Some key conclusions emerged from both studies. There is a gap in teaching about the social impact of materials with similar results identified in the survey (Vakhitova *et al*, 2015). Students found the Tool easy to use and worth the small effort needed to learn how it operates. They report that the tool provided a good introduction to the social issues surrounding the life cycle of a product, stimulated discussion and provided important input to understanding the global impact of engineering. Participants shared a number of positive and motivational messages, stimulated by their use of the Tool. Some have mentioned that even just knowing about such tool/ratings helps to understand about a wider impact product has than those immediately apparent. And that this should make engineers and designers more considerate about designing with sustainability in mind, what would be also important for personal motivation and career aspirations. In the second case, it was decided to use the Tool in a future workshop for faculty members on how to meet the new ABET requirements.

Participants sought reassurance that the data would be regularly updated and requested more guidance in drawing conclusions and creating the final report. Some struggled to understand the normalised data and the hotspot-threshold. Others mistakenly added the number of hotspots to give a total, failing to understand that a hotspot is a flag for further research and possible action, not penalty-point for social misjustice. It seems that most students did not read the accompanying paper explaining how the Tool works. Neither group was explicitly asked to do any reading (e.g. accompanying White Paper) prior to being introduced to the Tool. A short video (5 -10 min), describing the Tool and the approach with a case study, would be helpful. This is now planned.

At a deeper level, the feedback highlighted the need for more help in using the Tool to guide decision-making. In particular, there is need for guidelines to promote discussion of the social responsibilities of companies operating in countries with identified Social Hotspots and the options available to these companies to ameliorate them. The complex interplay between economic, environmental and social factors is not, at present addressed; there is a clear need for resources to help teachers steer discussion of this central topic.

4 Conclusions

This paper describes feedback from trials of a new Excel-based Tool designed to introduce students to Social Life-cycle Assessment (S-LCA), following the UNEP / SETAC Guidelines. The Tool's key outcome is flagging "Social Hotspots" – the points in the life of a product at which potential harmful practices or opportunities to enhance well-being exist, based on an extensive set of socio-economic data.

Students found the Tool easy to use, worthwhile, and a stimulus for discussion of the social impacts of product life and the materials they contain. A number of challenges emerged. One is that of misunderstanding of the meaning of a Social Hotspot and the actions that follow when it is identified. This is unfamiliar territory of many engineering students, highlighting the need, for instance, for a short video support to provide the necessary background (reading material is not very popular). A second, is the need to place S-LCA in context of a broader life cycle assessment encompassing the environmental and economic, as well as the social, aspects of product life.

The trials form part of a strategy to develop GRANTA EduPack product as a resource to support the teaching of Sustainable Development. We are exploring ways in building the S-LCA tool into the existing

software in a way that is compatible with the present Eco Audit Tool for streamlined life cycle inventories that is one of its standard features. At the same time, we are developing material to run workshops, quizzes or microprojects to kick-off discussion around the topics that emerged as "needs" in the trials described here. We are actively working with collaborators to expand the Tool further and would welcome suggestions for its expansion and the directions in which it might be developed.

5 References

ABET Criteria for Accrediting Engineering Programs, 2019 – 2020
https://www.abet.org/accreditation/accreditation-criteria/criteria-for-accrediting-engineering-programs-2019-2020/#GC3

Ashby, M., Brechbühl, E., Vakhitova, T. and Vallejo, A. 2019, *White Paper: Social Life-Cycle Assessment and Social Impact Audit Tool*. https://grantadesign.com/teachingresources/papslcen19/

ASM Medical Materials Database (2020) ASM International, Materials Park, OH 44073-0002

Editorial. 2020. Get the Sustainable Development Goals back on track. *Nature,* 577, 7-8. https://www.nature.com/articles/d41586-019-03907-4

Kroll, C., Warchold, A. & Pradhan, P. 2019. Sustainable Development Goals (SDGs): Are we successful in turning trade-offs into synergies? *Palgrave Commun* 5, 140. https://doi.org/10.1057/s41599-019-0335-5

Life Cycle Initiative, Consultation on S-LCA Guidelines, 2020
https://www.lifecycleinitiative.org/consultation-on-s-lca-guidelines-now-open/

United Nations. 2015. *Transforming our World: The 2030 Agenda for Sustainable Development.* https://sustainabledevelopment.un.org/post2015/transformingourworld/publication

United Nations Environment Programme. 2009. *The Guidelines for Social Life Cycle Assessment of Products* http://www.unep.fr/shared/publications/pdf/dtix1164xpa-guidelines_slca.pdf

Vakhitova, T., Shercliff H., Ashby, M., 2015, Taking Stock: Sustainability in Engineering Teaching; case of CES EduPack – software for academics, Proceedings EESD 2015.
https://open.library.ubc.ca/cIRcle/collections/52657/items/1.0064736