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Navigating social sustainability in engineering education: student experiences and challenges of using a social impact audit tool in a product design project

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Introduction

The social dimension of sustainable development, critical to achieving the first five Sustainable Development Goals (SDGs), remains underexplored in product design (Corsini & Moultrie, 2021). Design support for assessing the social sustainability of product concepts is limited and the social pillar remains the least developed in engineering education (Gould et al., 2017; Mesquita & Missimer, 2020).

Understanding social impacts is important for product lifetime extension as it ensures that interventions promote inclusivity, equity, and societal wellbeing. Product designers need tools that provide clear, reliable data to guide material and design choices, enabling the design of products with reduced long-term impacts.

Assessing social impacts is commonly done through Social Life Cycle Assessment (SLCA), which is well-established and various methods exist (Wu et al., 2014). Yet, SLCA is typically time- and resource-intensive, requiring detailed data that is limited in early-stage design. Tools that help designers assess social impacts during the design stage are still limited (Gould et al., 2017).

Emerging solutions, like the Social Impact Audit tool (SIAT) by Ansys (Ashby, Mike et al., 2019), can potentially bridge this gap. It provides a simplified and introductory approach to SLCA for design and engineering education. Using publicly available data, the tool ranks social impacts along production chains, from raw materials to end-of-life, enabling more informed and socially conscious design decisions.

The aim of this paper is to examine the challenges faced by industrial design engineering students using a social benchmarking tool during a bachelor-level product development course at Chalmers University of Technology. It explores the tool's potential to enhance critical thinking about social impacts and provide the next generation of product designers with the means to assess social impacts in the development of sustainable design solutions.

Methods

Research approach

A half-day workshop using the SIAT tool was held in the course Sustainable Development with 3rd year students in the industrial design engineering program at Chalmers University of Technology. In the course a total of 44 students divided over ten groups of 4-5 members each performed a qualitative sustainability analysis of an electrical consumer product and proposed measures to improve sustainability performance. Social impact was assessed using SIAT, a tool that analyzes publicly available data across 5 stakeholder groups (workers, consumers, local community, society, and value chain) and 31 social impact categories, converting them to a scale from 1 (least good practice) to 100 (best practice). The data and social impact categories are based on the UNEP/SETAC 'Guidelines for Social Life Cycle Assessment of Products'(United Nations Environment Programme, 2020). See figure 1 for an impression of the SIAT tool. The users select countries involved in the lifecycle phases of their product and set threshold limits to identify hotspots where impacts are unacceptable.

The workshop followed structured steps: (1) an introduction to social sustainability and SIAT, (2) an exercise refining a prior social impact analysis with different thresholds, and (3) an assignment applying SIAT to assess and improve the social impact of a student team's product. Groups worked on manufacturer-based scenarios using a baseline production chain. The session concluded with a survey to

gather feedback on tool usability and challenges.

Data collection and analysis

Data was collected in the form of completed Miro boards containing choices and reflections (n=8), survey responses (n=16), and observations by the workshop facilitator. Each Miro board was analysed and answers were captured (e.g., defined threshold value, prioritization of social impact indicators, written reflections about optimized production chain).

the tool's calculations, many struggled to define acceptable social impact values and prioritize categories. A crucial step in understanding and defining acceptable social impact was exploring data sources and aligning interpretations of social sustainability within groups. Furthermore, data reliability and transparency came up as a substantial challenge as some groups encountered values that they did not perceive to be correct, which raised uncertainty whether they could rely on the data.

5 Stakeholder groups, 31 Social Impact Categories →

201 Nations ↓

Stakeholders Categories	S1 Workers					S2 Consumers			
Nation \ Indicator	Hours worked per week	Women's share of labor force	Fatal accidents at work	Social protection expenditure	ITUC freedom of association	Public health spend per capita	Press freedom	Rule of law	Corruption perception index
Afghanistan (AFG)	70.0			10.8		17.9	32.5	3.0	3.0
Albania (ALB)	70.0	37.1	59.0	58.9	60.0	41.0	56.5	42.6	50.0
Algeria (ALG)	70.0	11.9	50.0	47.9	20.0	56.3	24.9	21.8	39.0
Andorra (AND)	70.0					76.8	81.5	90.1	
Angola (ANG)	31.0	89.1		38.6	40.0	24.7	29.8	12.9	8.0
Antigua and Barbuda (ANT)	70.0			68.2		47.3	78.8	63.4	
Argentina (ARG)	9.0	41.3	24.0		40.0	73.7	70.1	22.8	54.0
Armenia (ARM)	70.0	63.9	61.0	45.0		26.3	54.9	43.6	41.0
Aruba (ARU)								86.1	
Australia (AUS)	85.0		92.0	91.9	60.0	83.7	90.2	94.1	93.0

Set threshold limit
Unflag social hotspots
Copy rows to Report
Unselect all nations

	Stakeholders Categories	S1 Workers		
	Nation \ Indicator	Hours worked per week	Women's share of labor force	Fatal accidents at work
☐	Suriname (SUR)	16.0		21.0
☐	Swaziland (SWZ)	9.0		
☑	Sweden (SWE)	70.0	91.6	97.0
☐	Switzerland (SUI)	47.0	84.9	95.0
☑	Syria (SYR)	70.0	4.4	31.0
☐	Tajikistan (TJK)	70.0		72.0
☐	Tanzania (TAN)	16.0	100.0	

Figure 1. Impressions from the SIAT tool. Users can evaluate and compare social impact categories of 201 nations (top) and use threshold limits to identify social hotspots amongst impact categories and stakeholders. Image adapted from (Ashby, Mike et al., 2019).

Findings

Challenges of using the social benchmarking tool

The most prevalent challenges encountered by the students were (1) setting the threshold, (2)

balancing sustainability trade-offs, and (3) data reliability and transparency. The challenge of setting thresholds for social impact assessment emerged in written explanations, with half the groups arbitrarily selecting 50 as it implied the "better half" of impacts. Despite explanations of

Table 1. Challenges experienced by students during the workshop (n=16). Students were able to select a maximum of 3 challenges.

Challenge	% of respondents
Setting the threshold	50%
Balancing trade-offs between social, economic, and environmental sustainability	44%
Data reliability and transparancy	38%
Selecting social impact categories	31%
Comparing the data and scores	31%
Understanding how the social impacts relate to specific stages of the product lifecycle	19%
Prioritizing social issues and ethical considerations	19%

Experiences and reflections by the students

Overall, all the students agreed (75% strongly agreed, 25% agreed) that they found the tool helpful for assessing social impacts, and all could imagine using the tool again in future design projects and work. Most of the students saw the use of the tool primarily in the initial screening phase of the design process, to set social impacts constraints and eliminate unsuitable materials. When asked whether the workshop using the SIAT tool led to rethinking design choices (e.g., material choices) the students indicate a greater awareness of social impacts and reconsiderations of production location (see table 2).

Table 2. Answers by the students on the question whether the SIAT made them consider changes to the product design.

ID	Answer
1	*'Where we produce our materials and how the workers are affected by the social conditions. To change country maybe!'*
10	*'End of life, as I was very focused on the environmental impact of the production.'*
11	*'It did facilitate reasoning regarding design changes, even concerning categories I wouldn't have thought of without the tool.'*
14	*'Focus more on social rights, we thought more about environmental aspects before.'*

Conclusion

This paper examined the challenges experienced by students using a social impact audit tool in a sustainable product development project. Previous studies have noted the difficulty of systematically addressing social impacts in the product development process (Gould et al., 2017). The findings of the study indicate that the students see the tool as helpful in assessing social impacts during design projects. Experienced challenges relate primarily to setting thresholds of acceptable levels of social impact, balancing sustainability trade-offs, data reliability, and prioritizing social impact categories. Workshop observations indicate the potential of the tool in systematically identifying social hotspots but also emphasized the importance of allowing users to examine data sources and critically reflect on the various dimensions of social sustainability and how they are measured and quantified. A limitation is the small sample size, further research will consolidate findings through additional workshops. Limitations related to the tool may exist regarding perceived tool accuracy and integration with industry and other SLCA tools. Moreover, there is a need to understand potential tool risks such as oversimplifying social impacts e.g. by fixating on counting social hot spots rather than understanding the complexity of social impacts and setting thresholds for unacceptable countries that could lead to misconceptions of avoiding low-scoring regions entirely. Therefore, it is crucial to educate students that threshold values highlight risks rather than 'poor' practice, and that risks can be opportunities to enhance social sustainability amongst social impact categories.

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