

# Integrating sustainability considerations into product development: a practical tool for prioritising social sustainability indicators and experiences from real case application

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**Abstract** In this paper, a tool for prioritising social sustainability parameters in product development is described. The tool's core element is a two-step Delphi exercise carried out in the product development team. The purpose of the tool is to (i) select critical social impact indicators suitable for guiding the product development process, (ii) enhance the product development team's understanding in the field of social sustainability and (iii) engage the team in the sustainability assessment, with the further aim of ensuring the assessment's influence on the product development process. Applied in a real product development project, the tool proved successful for selecting indicators and increase understanding of social sustainability within the product development team. Selected indicators' usefulness for the product development process remains an open question to be addressed later on as the project evolves.

## 1 Introduction

The product development process is regarded a crucial intervention point for sustainable development in society [1,2]. In the life cycle management community, the focus on the social dimension of sustainability has increased over the past few years and is expected to further increase over the next decade [3-5]. While tools exist for considering environmental parameters in product development, there is a general lack of practical tools for considering social parameters. In 2009, UNEP and SETAC issued guidelines for social life cycle assessment (SLCA), drawing on the environmental life cycle assessment (LCA)

methodology [6]. However, there is a wide range of different approaches with regard to the methodology of SLCA, which is a sign of the immaturity of the field [7]. For example, no standard or commonly accepted set of metrics or indicators exist for measuring the social sustainability of a product life cycle [5,7-10]. Some researchers have tried to compensate for this by stakeholder engagement in selecting and rating indicators for other aspects of sustainability, thereby claiming that social aspects have been covered by inclusion of stakeholders' opinions and values in the process [11].

According to the experience of the authors, the product development processes of today, which often involve a multitude of representatives from academia and industry in diverse fields of expertise, frequently feature a lack of understanding of social sustainability. This must be effectively managed by tools used in the sustainability assessment, as it may aggravate data collection and hinder the assessment's influence on decision-making, critical elements in order for the assessment to successfully guide the product development process.

In this paper, a tool for considering social sustainability in early product development processes is described and its usefulness in application in a real product development case is analysed. The purpose of the tool is to (i) select critical social impact indicators suitable for guiding the product development process, (ii) enhance the product development team's understanding in the field of social sustainability and (iii) engage the team in the sustainability assessment, with the further aim of ensuring the assessment's influence on the product development process. Thus, the tool aspires to contribute to resolving the above outlined issues: the non-existence of standard sets of indicators and the common lack of knowledge with regard to social sustainability within product development teams.

## **2 Method**

The tool is based on the notion that a product's social impact is defined as its influence on people's well-being throughout its life cycle [6,12,13], and that this impact mainly depends on the conduct of companies involved in the life cycle towards their stakeholders and not on the production processes themselves [12-14]. The tool was developed with a life-cycle perspective in mind, in order to facilitate integration into a more comprehensive life-cycle oriented sustainability assessment of the three pillars of sustainability (e.g. including methods such as LCA and life cycle costing). An exercise carried out in the product development team is the core element of the tool. In the exercise, the Delphi method is used to rate a set of indicators on the social impact of a certain product life cycle.

## ***2.1 The Delphi method***

The Delphi method was developed as a means of obtaining reliable consensus in a panel of experts [15]. The method was originally used as a forecasting technique but has come to be used in a broader range of applications [15]. For example, it has been used for structured group communication when dealing with complex problems including subjective judgements [16], which is the area of application in this study. In such contexts, the method's main characteristic is perhaps its ability to produce useful guidance [17].

Traditionally, the method includes the following elements: (i) individuals anonymously contribute to a group judgement (e.g. by answering a questionnaire asking for ratings of a number of options), (ii) the group judgement is assessed (e.g. as a statistical summary of the ratings) and (iii) individuals are given the opportunity to adjust their view following feedback on the group's judgement [16]. Usually, the process is repeated until the responses meet a certain level of stability (e.g. the mean of the ratings does not change significantly between rounds), which is then considered a fairly reliable measure of the group's opinion [15].

The strengths of the Delphi method primarily lie in its anonymity, which aims at avoiding social pressures within the group, and its iterative approach, which facilitates sharing and reconsideration of opinions [15]. Critiques of the Delphi method often emphasize its inability to perform better forecasts than other techniques or that it can be costly compared to other structured group interaction procedures [15].

In this study, a simplified Delphi method limited to one round of feedback is used: the two-step Delphi method. This was done due to the requirements on the tool of being practical as well as time and resource efficient. Besides, it was deemed sufficient for the purpose of the exercise.

A few cases of using the Delphi method for rating sustainability indicators can be found in literature [18-20]. However, the authors are not familiar with any previous attempts of applying the Delphi method for rating social sustainability indicators in a product development context.

## ***2.2 Procedure of the social sustainability assessment tool***

The social sustainability assessment tool consists of the following steps:

- 1) An oral presentation is held for the product development team, introducing the field of social sustainability and the exercise.

- 2) The team members anonymously rate a preselected set of indicators of how companies in the product life cycle influence stakeholders on a 1-10 scale regarding two dimensions: general importance and relevance for the specific product life cycle. Team members are also given the chance to provide written comments on their ratings.
- 3) The participants are given the opportunity to revise their ratings after receiving feedback on the team's mean rating on each indicator, the rating's standard deviation and the comments relating to ratings that fall outside of the standard deviation.
- 4) The revised rating of the general importance and the specific relevance are multiplied, generating a final score on a 1-100 scale for each indicator. This score is then used in the further sustainability assessment, e.g. for selecting indicators to be used for guiding the product development process.

### **3 Real case application**

The tool was applied in an on-going product development project featuring applied technical research with the aim of developing a new material for consumer products. Representatives from 10 different organizations, including both academia and industry, are involved in the project. The project is organized into a number of work packages, whereof one is dedicated to the sustainability assessment. Decision-making, e.g. regarding viable routes of development, which the sustainability assessment seeks to influence, is done in every-day project work as well as in steering committee meetings. Within the project team, different members have different perspectives and various levels of previous knowledge in the field of social sustainability.

The project has a goal of contributing to a more sustainable society. The holistic perspective of the triple bottom line and the importance of a life cycle perspective are highlighted in the project's guiding documents. However, project objectives do not outline specific sustainability parameters to focus on (e.g. specific impact categories or social themes). Hence, it is part of the sustainability assessment to identify the critical sustainability parameters.

### ***3.1 Indicator set used in the exercise***

Following a literature study on social sustainability indicators proposed for sustainability assessments, 74 indicators were identified. The set was narrowed down to 36 indicators by merging, rephrasing and excluding indicators, based on four criteria acquired from Spillemaeckers et al [14]: measurability, relevance to the specific product, feasibility with regard to the resources at hand and applicability in the particular project. Selected indicators are found in Table 1. Each indicator was allocated a social theme<sup>1</sup> and assigned to the most suitable of the stakeholder categories outlined in the UNEP/SETAC SLCA guidelines [6]: employees, local community, society, consumers and value-chain actors. However, a few indicators may reflect impact relevant to several stakeholders. Indicators either relate to activities of specific companies or to the general situation in the companies' sector or region of operation, which may be suitable for hotspot identification in case the firms to be involved in the product system are either unknown or difficult to assess. Some indicators are phrased precisely as in the original reference(s) listed in the table; others have been rephrased and/or merged to better fit the case application. Indicators may be yes/no questions, or require quantitative answers, qualitative descriptions, or a combination of these. Also the final score (product of the general importance and specific relevance ratings), as obtained in the case application, are displayed in Table 1.

### ***3.2 Procedures of case application***

Fourteen project partners' representatives participated in the exercise, whereof three represented industry partners and 11 represented other partners, including research institutes and academia. All participants except one were present for the introductory oral presentation, which was held in connection to a larger project meeting. The exercise was carried out by means of a Microsoft Excel questionnaire and e-mail communication. A two-page briefing on social sustainability, sustainability assessment and the exercise procedures was attached to the questionnaire.

After completion of the exercise, the participants were asked to reply to an anonymous online questionnaire, including seven yes/no/no opinion questions on how they perceived the exercise and the result's future usefulness. The respondents also had the opportunity to provide written comments to their replies.

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<sup>1</sup> "Social theme" is alternately referred to as "social impact category" in SLCA contexts [6].

**Tab. 1: Social sustainability indicators used in the case application and final scores.**

Social theme	Indicator	Reference(s)	Final score
<b>Stakeholder category: employees</b>			
Health and safety	Presence of formal policy on health and safety	21	58.0
Health and safety	Average number of lost workdays due to injury/illness per year	22-25	58.4
Safety	Are emergency escape routes clearly marked and sprinkler systems and fire extinguishers installed in the company premises?	26	58.5
Employment security	Percentage of workforce on permanent employment contract	24	35.2
Professional development	Average number of hours employee training per year	22-25	37.6
Working hours	Clear communication of working hours and overtime arrangements and respect of contractual agreements concerning overtime	21	48.5
Child labour	Assessment of child labour reports by sector/region of operation (e.g. according to UCW country reports)	27	48.9
Child labour	Records on all workers stating names and ages or dates of birth are kept on file	21	52.5
Freedom of association and collective bargaining	Evidence of restriction to freedom of association and collective bargaining in sector/region of operation (e.g. according to International Trade Union Confederation Annual Survey of violations of trade union rights, LabourStart reports or organizations' GRI Sustainability reports)	14,21,24	42.5
Fair salary	Payment ratio (salary of upper 10% of employees/salary of lower 10% of employees)	22	35.2
Fair salary	Wages amount to at least living wage (or, if higher, minimum wage) for the concerned region at all times (e.g. according to SweetFree Communities' reports on non poverty wages)	14,21,24,28	51.1
Equal opportunities/discrimination	Ratio of average salary of men to women	21,24	41.4
Social benefits/social security	List of short descriptions of social benefits provided to workers (health insurance, pension fund, child care, education, accomodation, etc.)	21,29	43.2
Social benefits	Percentage of permanent workers receiving paid time-off	21	31.7
Social benefits	Average length of annually paid vacation	30	39.2
Work conditions (general)	Contracts stipulate wage, working time, vacation, terms of resignation and are kept on file	28	56.2
Work conditions (general)	All employees have the possibility to file complaints about labour practices which conflict with the principles of employment on a voluntary basis, in confidentiality and without negative consequences	28	51.9
Work conditions (general)	Does the country of operation ratify all ILO core labour standards and/or are there any known work condition issues in the region/sector of operation?	31	44.4
Respect of human rights	Existence of media reports within the last 5 years on human rights violations or discrimination	14,21,24	35.6
<b>Stakeholder category: local community</b>			
Community development/social justice	Community spending and charitable contributions as percent of revenues	14,22,23,25	17.3
Community development	Number of working hours per functional unit	5,32	34.6
Secure living conditions	Strength of public security in country of operation (e.g. ranking in World Economic Forum Global Competiveness Report)	21	35.1
Respect of freedom of expression	Freedom of expression in country of operation (e.g. according to Freedom House publications or Amnesty International human rights reports)	21	33.8

Respect of cultural heritage	Is relevant organizational information available to community members in their spoken language(s)?	21	31.7
Conflicts with local community	Number of complaints from neighbours/local community during the last 5 years	14,22,25	47.1
<b>Stakeholder category: society</b>			
Public commitments/transparency	Presence of publicly available code of conducts, agreements or other document on promises on sustainability issues (e.g. Global Compact, Sullivan principles, Caux Round Table, UN principles or GRI reports) and mechanism to follow-up the realisation of these promises	21	51.1
Contribution to economic/technology development	R&D costs as percentage of turnover	21,25,31	51.8
Corruption	Identification of potential corruption hotspots in region/sector of operation (e.g. by reviewing the Corruption Perception Index published annually by Transparency International)	21	39.5
Transparency	Presence of annual Corporate Social Responsibility and Environmental Sustainable Development reports	21,23	40.9
Prevention and mitigation of armed crisis	Is the organization doing business in a sector that features linkages to conflicts, e.g. where the depletion of resources allows significant profits?	21	60.1
<b>Stakeholder category: consumers</b>			
Consumer feedback	Presence of consumer feedback mechanism (after sale services, regular consumer satisfaction studies, etc.)	14,21	32.5
End-of-life responsibility	Do internal management systems ensure that clear information is provided to consumers about end-of-life options (if applicable)?	21	50.5
Extra customer benefits	Extra product or service benefits that enhance customer well-being (compared to competitors)	29	32.4
<b>Stakeholder category: value-chain actors</b>			
Fair competition	Documented statements or procedures (policy, strategy, etc.) to prevent engaging in or being complicit in anti-competitive behaviour	21	33.1
Fair competition	Is the enterprise subject to legal actions regarding anti-competitive behavior and violations of anti-trust and monopoly legislation, or are there any known non-compliance with industry regulations?	21,24,25	36.0
Promoting social responsibility	Presence of explicit code of conduct that protects human rights and workers among suppliers and/or membership in an initiative that promotes social responsibility along the supply chain	21	56.0

## 4 Results and discussion

Table 1 displays the final scores of the exercise, as applied in the case study. It is imperative to keep in mind that these scores depend on the context of the specific product development project and the values, knowledge and experiences of the participants. The subjective nature renders the scores inappropriate to use for external communication in situations in which they may be interpreted as reflecting the official view of involved partners. Neither shall the scores be viewed as a final verdict on the importance of different social sustainability parameters. The result is displayed in this paper merely as an example of final scores.

The considerable differences between the final scores (spanning from 17.3 to 60.7, see Table 1) justify the exercise as a basis for defining a smaller and more manageable set of indicators. This was done by selecting the overall top 10 ranked indicators and the 10 indicators ranked highest among the industry partners, a breakdown done in order for the industry partners to have a larger influence on the selection process. This was considered reasonable as the industry partners were more experienced in the field of social sustainability than other project partners, and represent organisations that will be held responsible for the project outcome in case it is commercialised. In a few instances, indicators on the two top 10 lists were regarded too similar, e.g. representing the same social theme. In one of these instances, the indicators were rephrased and merged; in all other cases the highest rated indicator was selected. In order to cover all stakeholder categories, the top rated customer indicator was also included, although it was on none of the two top 10 lists. In this way, a set of 13 indicators was selected. This is one example of how a set of indicators could be selected based on the exercise result. However, procedures will probably have to be tailored on a case-to-case basis. This applies to the whole tool as well; it should be adapted to fit each product development project, for example depending on the resources at hand. Adaptations could include e.g. altering the indicator set used in the exercise, including more feedback rounds in the Delphi process or reformulation of the criteria used for rating. Consideration should always be given to recent developments in the field of sustainability assessment, for example to newly developed indicators.

Seven of the 14 exercise participants replied to the feedback questionnaire. Although this is a weak basis for far-reaching conclusions, a few things can be said. Six respondents stated they had, by participating in the exercise, acquired a clearer understanding of social sustainability. This indicates that the exercise did contribute to the aim of increased understanding of social sustainability within the project team. Only four respondents answered that they believe the 13 indicators selected based on the result of the exercise will be practical and meaningful (i.e. have a clear connection to the work in the project) for evaluating the project outcome's social sustainability in relation to comparable products. As considering social sustainability parameters in technology intensive product development is not yet common practice, it is not surprising that an early attempt in this area is met with some doubts. The underdeveloped methodology and lack of case application experience even in the life cycle management community, indeed justifies some degree of scepticism. Furthermore, one respondent expressed doubt regarding the practicability of using the indicators for assessing production systems which are not yet up and running. This is a persistent challenge of sustainability assessment in product development [33,34], which will have to be managed when applying the indicators for evaluating product systems.



Two respondents expressed doubt that the 13 selected indicators will adequately cover the project outcome's social impact. This emphasizes the need for keeping an open mind towards social impacts not covered by the indicators. The sustainability assessment practitioner has to be particularly cautious when it comes to coverage in case there is a stage in the product life cycle which none of the participants' is well-acquainted with.

Following the second round of rating, the average standard deviation for the team's average ratings decreased from 2.98 to 2.78 for the general importance, and from 2.04 to 1.94 for the relevance. Although a moderate change, this indicates an increased consensus following the second round of the exercise.

From follow-up talks with the participants, it turned out there were four different interpretations of the relevance rating: (i) relevance with respect to what can be influenced in the product development process, (ii) relevance for the specific processes under development, (iii) relevance for the entire product life cycle and (iv) relevance for comparisons with conventional products with a comparable functional unit. The different interpretations emphasize the importance of being clear and precise in explaining the exercise and to keep in mind that all participants may not be used to life cycle thinking.

The main criticisms of the Delphi method, i.e. its shortcomings as a forecasting technique and its resource inefficiency [15], are not considered serious drawbacks of the method as applied in this study: the tool is not used for forecasting, the exercise is limited to one round of feedback and the communication, except for the oral presentation, is managed via e-mail (which, in comparison to physical meetings, tend to be inexpensive and time efficient).

## **5 Conclusions**

This paper reports on a tool for selecting critical social sustainability indicators early in the product development process. The following list summarizes the major outcomes and conclusions from application in an on-going product development project.

- Thirteen indicators were selected based on the result of the exercise. The suitability of these for guiding the product development process remains an open question to be addressed later on as the project evolves.
- The tool enhanced the product development team's understanding of social sustainability. Hopefully this will facilitate data collection and increase the assessment's influence on decision-making.

- The tool was practical to implement and proved time and resource efficient, valuable characteristics of sustainability assessment tools in product development processes.
- The ratings produced in the exercise are not to be seen as a final verdict on the importance of different social parameters. Also, an open mind must be kept towards social impacts not covered by the indicators.
- The tool is considered particularly useful as long as no standard sets of indicators exist for measuring the social impact of product life cycles. Even when such sets exist, the tool can be useful in selecting the most relevant indicators for the specific case.
- The tool's main drawback is the result's subjective nature. However, some degree of bias is inevitable in the art of assessing the social impact of a product, and when subjective group judgement is required the Delphi method is considered an appropriate instrument to capture the opinions.

## 6 References

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