Societal LCA (Subject Editor: David Hunkeler)

Methodologies for Social Life Cycle Assessment*

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Abstract

Goal, Scope and Background. In recent years several different approaches towards Social Life Cycle Assessment (SLCA) have been developed. The purpose of this review is to compare these approaches in order to highlight methodological differences and general shortcomings. SLCA has several similarities with other social assessment tools, although, in order to limit the expanse of the review, only claims to address social impacts from an LCA-like framework are considered.

Main Features. The review is to a large extent based on conference proceedings and reports, which are not all easily accessible, since very little has been published on SLCA in the open literature. The review follows the methodological steps of the environmental LCA (ELCA) known from the ISO 14044 standard.

Results. The review reveals a broad variety in how the approaches address the steps of the ELCA methodology, particularly in the choice and formulation of indicators. The indicators address a wide variety of issues; some approaches focus on impacts created in the very close proximity of the processes included in the product system, whereas others focus on the more remote societal consequences. Only very little focus has been given to the use stage in the product life cycle.
Another very important difference among the proposals is their position towards the use of generic data. Several of the proposals argue that social impacts are connected to the conduct of the company leading to the conclusion that each individual company in the product chain has to be assessed, whereas others claim that generic data can give a sufficiently accurate picture of the associated social impacts.

Discussion. The SLCA approaches show that the perception of social impacts is very variable. An assessment focusing on social impacts created in the close proximity of the processes included in the product system will not necessarily point in the same direction as an assessment that focuses on the more societal consequences. This points toward the need to agree on the most relevant impacts to include in the SLCA in order to include the bulk of the situation.
Regarding the use of generic data as a basis for the assessment, this obviously has an advantage over using site specific data in relation to practicality, although many authors behind the SLCA approaches claim that reasonable accuracy can only be gained through the use of site specific data. However, in this context, it is important to remember that the quality of site specific data is very dependent on the auditing approach and, therefore, not necessarily of high accuracy, and that generic data might be designed to take into account the location, sector, size and maybe ownership of a company and thereby in some cases give a reasonable impression of the social impacts that can be expected from the company performing the assessed process.

Conclusions. This review gives an overview of the present development of SLCA by presenting the existing approaches to SLCA and discussing how they address the methodological aspects in the ISO standardised ELCA framework. The authors found a multitude of different approaches with regard to nearly all steps in the SLCA methodology, thus reflecting that this is a very new and immature field of LCA.

Recommendations and Perspectives. SLCA is in an early stage of development where consensus building still has a long way. Nevertheless, some agreement regarding which impacts are most relevant to include in the SLCA in order to cover the field sufficiently seems paramount if the SLCA is to gain any weight as a decision support tool. Furthermore, some assessment of the difference between site specific and generic data could give valuable perspectives on whether a reasonable accuracy can be gained from using generic data or whether the use of site specific data is mandatory and, if so, where it is most important.

Keywords: Environmental life cycle assessment (ELCA); generic data; indicators; product life cycle; review; site-specific data; social life cycle assessment (SLCA)

Introduction

The debate on sustainable development has spurred initiatives on methods for assessing environmental, social and economic impacts. In relation to this development, there has been an increasing interest for the inclusion of social aspects into the environmental life cycle assessment of products and systems in recent years. This task has been commenced in the development of the so-called Social Life Cycle Assessment (SLCA). Experience with SLCA is growing and is be-

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ing developed to include a multitude of impacts, ranging from direct impacts on workers to broader societal consequences. Decision-makers from several different areas have found interest in SLCA, such as decision-makers on investment (Methot 2005), design (Schmidt et al. 2004, Gauthier 2005), industrial management (Cañeque 2002, Schmidt et al. 2004, Dreyer et al. 2006, Nazarkina and Le Bocq 2006), consumers (Spillemaeckers et al. 2004) and public decision making (Hunkeler 2006). Also, a number of methodologies have been created without a specified target group of users (Barthel et al. 2005, Flysjö 2006, Manhart and Grießhammer 2006, Norris 2006, Weidema 2006). Furthermore, SLCA-like Internet databases are under development, having the goal to make data broadly and easily accessible to a wide range of users (Earthster 2007). Because of the limited, available descriptions, this initiative will not be discussed any further.

In this review we try to draw a picture of the present landscape of SLCA by analysing the existing methodology and proposals for SLCA based on the sources mentioned above. Especially the report made by Nazarkina and Le Bocq (2006), which was already a review and analysis of SLCA methodologies, has served as a basis for this article.

The review is based on a thorough literature survey including journal papers and, in particular, less easily accessible sources like conference proceedings and reports, as very little has been published until now in peer-reviewed journals.

The review attempts to highlight the general points of agreement and disagreement among the authors and tries to give a specific focus on the methodological shortcomings, thereby giving a picture of the degree of maturity in the already available proposals.

The presentation and discussion of the methodologies follows the general methodological framework of the SLCA as proposed by the UNEP-SETAC Life Cycle Initiative Cross cutting taskforce 3 on integration of social aspects in LCA, similar to the framework for Environmental LCA (ELCA) laid out by ISO 14040, namely: Goal definition; scope definition; inventory analysis; and impact assessment (Grießhammer et al. 2006). The interpretation phase will not be discussed here.

SLCA is developing in a scientific field with many parallels to methodology discussions in Cost Benefit Analysis (CBA), Social Impact Assessment (SIA), social accounting and others. It was chosen in the review only to include methodology proposals that claim to assess social impacts based on an LCA-like framework. A consequence of this approach is the omission of methodology proposals with no claimed connection to LCA methodology, even though they may have some relevance to the overall goals of SLCA.

1 Goal definition of an SLCA study

In spite of their short history, SLCA-approaches have already been developed to support several different goals. As in ELCA, two main classes of goals can be identified. One is product, process or company comparison, herein also labelling and social responsible investments, as exemplified by Schmidt et al. (2004), Spillemaeckers et al. (2004), Méthot (2005). The other class is identification of product or process improvement potentials (Flysjö 2006, Gauthier 2005, Dreyer et al. 2006, Manhart and Grießhammer 2006). These classes of goals should be seen as complementary. Different goals have implications for the methodological possibilities and limitations, which will be discussed in the following. Still, several of the approaches do not specify one specific goal, such as Barthel et al.(2005), Norris (2006) and Weidema (2006).

2 Scope definition of an SLCA study

The objective of the scope definition is to identify and to define the object of the study and to delimit the assessment. In this section, the origin of social impacts, allocation, system boundary setting and social indicators will be discussed.

2.1 The origin of social impacts

Product systems or service systems are often composed of many processes. In ELCA it is generally accepted that the environmental impacts arise because of the nature of these processes. In other words, there is a causal link between process and environmental impact. The environmental assessment, thus, is based on an aggregated inventory of input and output for processes that are needed to provide the function defined in the functional unit.

Regarding SLCA, on the other hand, it has been discussed whether this is a valid approach. Dreyer et al. (2006) and Spillemaeckers et al. (2004), for example, argue that most social impacts have no relation to the processes themselves, but rather to the conduct of the companies performing the processes. The causal link is therefore not from process to social impact, but from conduct of the company to the social impact. They argue therefore that the SLCA inventory analysis should be focused on the companies involved in the product system. Schmidt et al. (2004), on the other hand, maintain that the focus on the process is the basis for the assessment as used in the ELCA.

2.2 Allocation

The discipline of allocation in ELCA deals with the division of impacts between the product system under study and one or more other product systems with which it interacts. Following this definition, allocation in SLCA has been addressed in relation to the above question of the origin of impacts. The problem that arises with regard to the approach presented by Spillemaeckers et al. (2006) and Dreyer et al. (2006) is how much of the company's total social impacts should be allocated to the process included in the assessed product or service.

Dreyer et al. (2006) propose that a share of the total amount of impacts created by the company involved in the product system should be allocated to the assessed product or service, and that the share should be determined by the weight that the company is given in the product's or service's total product chain. The share factor or allocation principle could be based on value creation, number of labour hours spent or the like.

A rather different approach towards allocation is taken in the socio-labelling initiative presented by Spillemaeckers et al. (2004). In this approach, each company included in the assessment has to comply with the standard set by the label. If the standard is met, the label can be awarded. As it is the whole company that is assessed, no allocation needs to be made, regardless of the fact that some of the company's processes might not be involved in the life cycle of the assessed product or service.

2.3 System boundaries

With the goal to support management decisions, the approaches presented by Méthot (2005) and Dreyer et al. (2006) narrow their focus to those parts of the life cycle that the company performing the assessment can influence directly. The application of the SLCA thereby justifies that only the company and its closest suppliers and distributors are assessed. Schmidt et al. (2004), on the other hand, focus on product comparison, and, since relevant impacts can be located in all parts of the chain, a full life cycle assessment is necessary.

As in ELCA, cut-off criteria are used in SLCA to set boundaries. In the Sustainable Development label (Spillemaekers et al. 2004), the cut-off criteria depend on the expert judgement. Another more formalised approach proposed by Barthel et al. (2005) is to use the ISO 14044 (2006) definition of cut-off criteria in LCA, substituting the words 'environmental significance' with 'social significance'. The ISO 14044 definition, if a process contributes more than a certain defined amount to a given quality, implies that the process has to be included.

In line with this statement, Weidema (2005) advocates the need to apply the ISO 14044 framework also in boundary setting in SLCA, implying that the exclusion of life cycle stages, processes, inputs or outputs is only permitted if it does not significantly change the overall conclusions of the study.

2.4 Social indicators

In Table 1 and **2**, the different SLCA approaches are characterised according to the impact categories they include, stating the number and type of indicators for each impact category. The indicator type refers to whether it is quantitative or qualitative/descriptive. Quantitative indicators can be based on measurements in physical units, semi-quantitative scores, or yes/no scores.

Some SLCA approaches use midpoint indicators, others use endpoint indicators. This difference refers to the location of the indicators in the impact pathway. For example, job creation is normally not considered a goal in itself but, through contributing to the family income and subsequent poverty reduction, it may improve the family's health conditions, which may be considered as an end goal. In this example, the job creation could thus be considered a midpoint indicator, and the health condition as the endpoint indicator. The two types of indicators are in principle linked by a so-called impact pathway describing the cause-effect relationship between mid-point and endpoint, but this relationship is often difficult to express. The two classes of SLCA approaches are thus presented in separate tables.

In the midpoint-based approaches, there is a great variety of issues being included. Because of the limited scope of this article, it has been necessary to create some generalised impact categories inspired from the Global Reporting Initiative (2007), thereby reducing the original complexity somewhat. Because of the close relation between several of the impact categories, and due to the sometimes superficial description of the indicators in the documentation, the categorisation of the indicators may be debatable in some cases. For a more complete picture, the reader is thus referred to the original sources.

Furthermore, in several of the midpoint-based approaches, the indicators are not shown. In these cases, the type and number of indicators included on the impact categories have been deduced from statements about what is considered in the SLCA approach.

Table 1 shows the highest frequency for indicators concerning discrimination and physical working conditions. Depending on the scope of the SLCA, the inclusion of the impact categories concerning other human rights, society and labour practices, and decent work conditions, appears to be the next priority.

As pointed out by Nazarkina and Le Bocq (2006), indicators are generally defined at the level of the organisation and not at the level of the individual. For example, the individual conflicts between manager and employees are generally not considered.

It is also noticeable that the impact categories which only allow negative scores are predominant in the mid-point based approaches. In relation to forced labour, for example, it would not be possible to obtain a 'good score', but merely to vary from OK (no forced labour) to poorer.

Only two SLCA approaches have been identified using endpoint indicators (see Table 2), and these are rather different, so it is difficult to point out any trends.

As has been mentioned, some of the approaches use midpoint and some endpoint indicators. Which type of indicator to use is an ongoing discussion in the field of ELCA, although it may yet become even more relevant in SLCA. Endpoint indicators have the advantage that they can reflect the potential damage or benefit to the valued item, known as the Area of Protection of the LCA (see below for further explanation), having the advantage, in theory, that no subjective weighting is needed. However, connecting the stressors that create the impacts and the Areas of Protection requires that the impact pathway is established. It has to be quantifiable and stable. Weidema (2006) states that these impact pathways can be established to an acceptable level of accuracy. Because midpoint indicators are closer to the stressors and also more understandable for decision makers, Dreyer and Flysjö state that these are to be preferred (Grießhammer et al. 2006).

Table 1: Impact categories and indicators at midpoint level

Impact categories	Number of indicators, quantitative/descriptive (q/d):											
	Barthel et al.	Cañeque	Dreyer et al.[1]	Flysjö[2]	Gauthier	Hunkeler	Manhart & Grießhammer	Méthot[3]	Nazarkina & Le Bocq[4]	Schmidt et al.	Spillemaeckers[5]	Included in approaches
Human rights												
Non-discrimination, including indicators on diversity, such as composition of employees on all levels according to gender, age group, disabled, part-time workers and other measures of diversity	2,q	10,q	1,q	3,q	1,d		1,d	?,q	4,q	5,q	2,q	10
Freedom of association and collective bargaining	2,q		1,q	1,d			1,d	?,q	1,q	1,q	8,q	8
Child labour, including hazardous child labour	2,q		1,q	1,d			1,d		1,q	1,q	3,q	7
Forced and compulsory labour	1,q		1,q	1,d			1,d		1,q	1,q	3,q	7
Labour practices and decent work conditions												
Wages, including equal remuneration on diverse groups, regular payment, length and seasonality of work and minimum wages	1,q	3,q		6,q 1,d			2,d	?,q	4,q	1,q	5,q	8
Benefits, including family support for basic commodities and workforce facilities				1,d		1,q	1,d		6,q	4,q		5
Physical working conditions, including rates of injury and fatalities, nuisances, basal facilities and distance to workplace	2,q	2,q	1,q	2,q 3,d	1,d		1,d	?,q	4,q	6,q	9,q	10
Psychological and organisational working conditions, such as maximum work hours, harassments, vertical, two-way communication channels, health and safety committee, job satisfaction, and worker contracts				1,d	1,d		2,d		10,q	1,q	8,q	6
Training and education of employees		2,q		2,d	1,d		1,d	?,q	6,q	1,q	2,q	8
Society												
Corruption, including incidents/press reports concerning fraud, corruption and illegal price-fixing, and violation of property rights.					1,d		2,d		2,q	1,q		4
Development support and positive actions towards society, including job creation, support of local suppliers, general support of developing countries, investments in research and development, infrastructure, and local community education programmes	6,q			1,q			12,d	?,q	12,q	8,q	5,q	7
Local community acceptance, such as complaints from society, and presence of communication channels					1,d			?,q	4,q	1,q	5,q	5
Ensuring of commitment to sustainability issues from and towards business partners							2,d				6,q	2
Product responsibility												
Integration of costumer health and safety concerns in product, such as content of contaminants/nutrients, other threats/benefits to human health (including special groups) due to product use, and complaint handling system				2,q	1,d					5,d	1,q	4
Information about product to users, such as labelling, information about ingredients, origin, use, potential dangers, and side effects.										1,q 2,d	2,q	2
Marketing communications, such as ethical guidelines for advertisements										1,d		1

Table 2: Impact categories and indicators at endpoint level

Impact categories	Number of indicators, quantitative/descriptive (q/d)	
	Norris	Weidema[6]
Mortality	1,q	?
Morbidity	1,q	?
Autonomy		15?,q
Safety, security and tranquillity		6?,q
Unequal opportunities		?
Participation and influence		?

The numbers, d, and q in Table 1 and 2 refer to the number of indicators included on the given impact category, and whether the indicators are descriptive (qualitative) or quantitative

[1] Dreyer et al. (2006) include both some universal indicators and some site-specific indicators that are defined locally. Only the former, which all address human rights of the workers are included in the table. Several of these, however, do also address impact categories included under the 'labour practices and decent work conditions' category.

[2] Flysjö (2006) includes some economic indicators not included in the table. These are: Production costs, values added and government subsidies.

[3] The SLCA-FIDD tool (Méthot 2005) is based on a questionnaire comprising more than 200 questions. The questionnaire is confidential and it is therefore difficult to state the exact number of indicators for each impact category included.

[4] The list of indicators is a summary based on many of the other SLCA approaches.

[5] Spillemaeckers et al. (2004) also include several indicators concerning environmental, overall management issues, such as compliance with legislation, that are not included in the table.

[6] Only examples of indicators are given in Weidema, 2006, hence the question marks.

Regarding impacts on the consumer in the use stage, very few impact categories are suggested. This may be due to the fact, as Dreyer et al. (2006) states, that the potential social impacts in the use stage are as different and variable as the products themselves. Flysjö (2006) uses the content of Omega 3 fatty acids in the salmon to illustrate one positive impact that the product might impose on the user. Grießhammer et al. (2006) agrees that the use stage is very difficult to assess and emphasizes the importance of the definition of the functional unit in this context. The function of the product or service should be defined in detail, both in quantity and quality in order to show qualities as time requirement, convenience and prestige. A quite parallel proposal is made by Dreyer et al. (2006) who suggest to including impact categories for the use stage on the basis of established product categories. Moreover, Grießhammer et al. (2006) mention, to the extent possible, that impact categories on the use stage should be chosen in accordance with internationally recognised texts on consumer impacts.

2.4.1 Area of protection

The creation of indicators implies a notion of some underlying themes of importance or, in this case, something that needs to be protected, consequently denoted as Areas of Protection (AoP). In ELCA there are four of these AoP, namely human health, natural environment, natural resources, and man-made environment (Udo de Haes et al. 2002).

However, several authors argue, when it comes to SLCA, that these AoPs do not suffice. Dreyer et al. (2006) have a lengthy discussion of the areas of protection considered in SLCA and the suitability of the traditional AoPs from ELCA to the impact assessment in SLCA. They propose a new area of protection: 'Human dignity and well being' to supplement the 'Human health' AoP addressed in ELCA. Weidema (2006) also discusses AoPs and concludes quite comparably to include not only human health but also its well-being.

2.4.2 Formulation of indicators

In the formulation of indicators for the categories of social impact, two important distinctions between the different methodologies become apparent. The first relates both whether the indicators are formulated in quantitative, semi-quantitative or qualitative terms. The second distinction concerns whether the indicator measures the impact directly or whether indirect indication or proxy measurements are applied.

When formulating quantitative indicators, it is assumed that the phenomenon to be measured can be directly quantified allowing for the application of units in time, cases or the like. Barthel et al. (2005), for example, propose using two indicators for measuring the impact category 'health and safety'. Both are based on statistical sources, one on the incidence of lethal injuries and one on the non-lethal injuries, implying a formulation of the indicator as being the number of lethal or non-lethal injuries, which allows for measurements in the metric 'cases per process'.

A scoring system, on the other hand, is often applied if the phenomena to be measured are too complex to measure and express in simple physical units. The scoring system typically presents ratings on semi-quantitative scales, for example ratings from good to bad, often expressed in corresponding numbers. An example could be the indicators used to measure the performance on 'occupational health and safety' in the approach presented by Spillemaeckers et al. (2004). They also use statistical sources on the frequency of accidents as in the above example, but include indicators on the presence of health and safety training of employees, presence of a health and safety committee, presence of a formal policy on health and safety, and several other indicators that are translated into numbers through the use of scoring systems.

The use of qualitative indicators does not set any restrictions on the types of information to include in the assessment and, thus, they can be used in a more exploratory manner than both the quantitative and semi-quantitative indicators. Gauthier (2005), for example, formulates in relation to the impact category 'quality, health and safety at work' that the product should meet the various quality or health and safety criteria in all stages of its life cycle. This very open formulation, however, should be seen in conjunction with the goal of her approach. Gauthier proposes a flexible assessment framework somewhat parallel to the semi-quantitative LCIA approach of the MECO matrix in ELCA (Wenzel et al. 1997) with the overall goal of highlighting potential problems in the product chain. Thereby, the need for a quantitative assessment becomes less essential.

Quantitative indicators are primarily used by Cañeque (2002), Barthel et al. (2005), Hunkeler (2006), Norris (2006), Schmidt et al. (2004), Weidema (2006), and Nazarkina and Le Bocq (2006), whereas Dreyer et al. (2006), Spillemaeckers et al. (2004) and Méthot (2005) make use of semi-quantitative indicators. Gauthier (2005) and Manhart and Grießhammer (2006) mainly use qualitative indicators as visible in Table 1 and 2.

The other distinction relates to whether indicators are designed to measure the phenomena directly, or indirectly or by proxy. Two examples will be given below.

According to Dreyer (2006), it is well known among companies which have experience with registration of working accidents, for example, that the registered number of accidents cannot always be correlated with the quality of work environment in the company. The problem of using the number of reported working accidents as an indicator is that it is strongly influenced by how well reporting of working accidents is managed. A low number of reported incidents may thus reflect both a very efficient management practice and a very poor management where incidents are simply not reported. For work environment as well as for other areas where use of reported impacts is questionable, Dreyer (2006) therefore introduces the idea of assessing the management effort rather than the reported impacts. The indicator measurement thereby becomes an assessment of the will and ability of the company to avoid negative impacts (hence of the risk that impacts will occur) and not an assessment of the reported impacts themselves. This aspect is not dealt with explicitly in other SLCA proposals; however, the indicators used in the approach presented by Spillemaeckers et al. (2004), to some extent include an assessment of both

reported incidents of social impacts and the quality of the management system.

Another and very different example of measurement by proxy is given by Weidema who suggests a method of reverse compilation from available data sources. Reverse compilation could be used in relation to child labour, for example: Regional or national statistics on child labour are very scarce but, assuming that the children are either in school or working during day hours, a rough proxy indicator measurement of the total extent of child labour in the region can be made on the basis of statistics on education and demography (Nazarkina and Le Bocq. 2006).

3 Inventory Analysis

The objective of the inventory is to collect relevant information, identified during the scope definition. However, the type of information to gather is a source of disagreement among the SLCA proposals.

Apart from the creation of common impact categories and indicators, one of the most challenging aspects regarding SLCA seems to be the data collection. In ELCA, generic data on the relevant input and output has been created for a large number of processes but, according to Dreyer et al. (2006) and Spillemaeckers et al. (2004), among others, several difficulties may arise using the same approach in SLCA. As previously mentioned, they see impacts as a result of the conduct of the company rather than because of the nature of the individual process. Accordingly, two companies producing exactly the same products (and possibly with the same environmental impacts as evaluated in an ELCA) can have completely different social impacts. Thus, they advocate that social impacts have to do with the behaviour of the company towards its stakeholders (as opposed to the industrial process in ELCA), making use of generic process data irrelevant or at best very difficult to apply. Dreyer et al. (2006) and Spillemaeckers et al. (2004) see the management of a company as a very local phenomenon, making the data collection a question of collecting site specific data as opposed to the generally accepted approach of using more generic process data in the ELCA. However, collecting site specific data from the whole product chain is obviously a very demanding task and, as discussed in the paragraph on the setting of system boundaries, several approaches have been taken to delimit the product chain in order to restrict the needs for data collection. Accordingly, Spillemaeckers et al. (2004) suggest using a screening based on literature, Internet and various databases in order to locate focus areas along the product chain, and thereby delimit the on-site data collection. Hereby, they are also advocated for the use of generic data, although only in situations where the probability of large negative social impacts are small.

Regarding the site specific data collection, few have described the process in detail. However, Spillemaeckers et al. (2004) give some overall guidelines on monitoring approaches.

Even though Weidema (2006), Schmidt et al. (2004), and Manhart and Grießhammer (2006) acknowledge that site specific data in general will lead to more accurate assessments, they still argue that using generic data from statistical databases (national, regional and global) can give a rough estimate on several social impacts. Also Barthel et al. (2004) propose the use of generic data from country and industry specific databases.

A third approach in relation to data collection is presented by Norris (2006) and Hunkeler (2006). The basic idea behind these two approaches is to use only a single impact category as a basis for the social assessment with a link to some broadly accessible generic data used as an indicator. Taking Norris (2006) as an example, he estimates mortality and morbidity impacts based on the assessed product or service production's contribution to increased GDP. The estimation is based on a statistical correlation between GNP rise and the mean life expectancy, which shows a very high positive correlation for countries with small GNP and a much smaller positive correlation for high income countries. Norris emphasises that estimations will be on the average, and that local conditions are likely to distort the picture.

The administrative advantage of using generic data is indisputable, as the assessment can be performed as a desktop study, giving a faster and less expensive assessment approach. Following these observations, Norris' (2006) and Hunkeler's (2006) proposals of including only a single indicator, for which data is easily obtainable, seems tempting. However, the comprehensiveness of both approaches is questionable and thereby their usability as a decision support. As an example, Norris' approach would always point towards the conclusion that products should be produced in the poorest possible country. Furthermore, the question of whether the accuracy of generic data is acceptable remains: Acknowledging that social impacts emerge primarily from the conduct of the specific company, how well can estimations based on generic databases resemble the assumed high accuracy of the site-specific data collection? Here, it should be noted that generic data could be made national or even sector specific as required, for example by Hunkeler (2006), instead of striving towards regionally or globally applicable data as in the ELCA.

4 Impact Assessment

The impact assessment is the phase of the ELCA where the inventory information is translated into impacts. The phase contains the classification, characterisation, and normalisation and valuation of impacts.

4.1 Classification

In ELCA, classification is normally performed by assigning inventory results to impact categories (ISO 14044). However, in the UNEP-SETAC Cross-cutting taskforce, a discussion has arisen concerning whether to follow the approach known from ELCA or to classify according to the impacted stakeholders (Grießhammer et al. 2006). For both classification approaches it is crucial to be as complete as possible, keeping in mind the goal of the study, as excluded stakeholders or impact categories will not give weight to the final results. It should be noted that the two approaches are not mutually incompatible.

For classification according to stakeholder groups the UNEP-SETAC taskforce on SLCA has agreed on a minimal list of stakeholders, including: Workforce (workers/employees); local community; consumers (related only to the use stage); and society (national and/or global) (Grießhammer et al. 2006). Schmidt et al. (2004) also propose the above mentioned, but furthermore includes business partners and future generations.

As discussed earlier and illustrated in Table 1 and 2, there is not an agreed list of impact categories, neither for midpoint approaches, nor for endpoint approaches.

4.2 Characterisation

The purpose of characterisation in ELCA, according to ISO 14044 (2006), is to aggregate the inventory results within the same impact category. This involves conversion of inventory data to a common metric.

As mentioned earlier, Weidema (2006) uses endpoint indicators, implying that he models inventory data to endpoint through impact pathways, based on the general idea to calculate all impacts as a reduction in the average well-being, denoted Quality Adjusted Life Years (QALYs). Each indicator has a severity, or impact factor, and an average duration. By summing the multiplications of incidence, severity and duration of each indicator, the total reduction in well-being can be calculated and expressed in years.

Two other approaches are presented by Barthel et al. (2005) and Schmidt et al. (2004). Barthel has three impact categories comprising 16 indicators. The indicators in each impact category have the same unit (e.g. seconds/functional unit) allowing for a simple summation of indicator scores resulting in a total measure for each impact category. Hereby, it is implicitly stated that the impact factor of each indicator is 1.

The approach of Schmidt et al. (2004) builds on the same principles, although a more detailed description is still under development.

Spillemaeckers et al. (2004) consider several of the impact categories as being complex phenomena, implying that up to eight indicators are needed to reasonably express its qualities. Each indicator is generally given the same impact factor, yet some are graduated in importance by classifying their compliance as either mandatory, in order to get the label, or voluntary. A very similar approach is taken by Dreyer (2006), however, whether or not Dreyer performs a characterisation is a matter of definition. Dreyer's indicators are based on many 'measures', i.e. questions to which the company should comply to get a good score. These measures could equally well be defined as indicators, implying that a characterisation is made.

Hunkeler's (2006) approach to characterisation is a bit different from other SLCA approaches. Hunkeler relates one indicator, the number of working hours along the production chain, to several impact categories, by assuming that the salary earned from the working hours is spent on improving the four impact categories: housing, health care, education and necessities (stressing that more impact categories should be added). Hunkeler's categorisation factors are estimated from the means of the average national costs of the commodities mentioned, expressed in working hours. By applying these characterisation factors to the working hours, a product's aggregated contribution towards obtaining these commodities can be calculated. The repartition of working hours into impact categories may be chosen according to a model of society. For example, an egalitarian society would give the same importance and then the same factor to every impact category.

Except for the approach presented by Weidema (2006) and Norris (2006), the whole concept of characterisation becomes somewhat different in SLCA than in ELCA, partly reflecting that the inventory analysis of many approaches collects information about impacts or behaviour predisposing impacts rather than on the kind of fundamental behaviour which would parallel the physical flows which are inventoried in ELCA. To give an example in ELCA, a CFC11 emission does not only contribute to the impact category ozone depletion, but also to global warming. In SLCA, a quantification of an indicator representing child labour impacts would not be relevant as a measure of discrimination impact or other social impacts. There is presently no consensus regarding these cause-effect relationships, and the characterisation approaches seem more oriented towards simplification of inventory results than towards a characterisation in line with the ELCA methodology.

4.3 Normalisation and valuation

Very little work has been done on these elements of the SLCA. Grießhammer et al. (2006), Schmidt et al. (2004) and Weidema (2006) discuss the issue of normalisation, and Schmidt et al. (2004) also gives a discussion on valuation. The general trend is that normalisation and valuation in SLCA are suggested to be performed like in ELCA.

5 Conclusions

The review has given an overview of the present development of SLCA by presenting the existing approaches to SLCA and discussing how they address the methodological aspects in the ISO standardised ELCA framework.

The review found a multitude of different approaches with regards to nearly all steps in the SLCA methodology, reflecting that this is a very new and immature field of LCA.

We are still in a situation where a number of fundamental issues have not been agreed on and resolved. One fundamental issue seems to be which impact categories to include in the assessment and how to measure these. Some degree of consensus regarding this point seems paramount if the SLCA is to gain any weight as a decision support tool.

One problem in this regard is that the perception of social impacts is very variable. This point can be illustrated by comparing the midpoint-based approaches and, for example, the approach presented by Norris (2006). In the midpoint-based approaches, it was illustrated that the impact

categories included are closely related to the direct impact on workers and society. The very different approach presented by Norris (2006), on the other hand, showed how social impacts can also be assessed from a much more macroeconomic perspective. Finally, as pointed out by Nazarkina and Le Bocq (2006), indicators are generally defined at the organisational level and not the individual. The area of social impacts is thus very wide. If the SLCA is to give an adequate assessment of the social area, this width must either be accounted for, or some agreement upon the most important impacts to include in the SLCA must be reached.

Another problem is that the question of how to measure the social impacts is equally an area for disagreement. Barthel et al. (2005), for example, use direct quantitative measurements, whereas Dreyer (2006) advocates the need for proxy measurements using scorecards for semi-quantitative measurements.

The degree of complexity needed for measuring these social impacts is another fundamental issue. Some approaches advocate a detailed and site specific investigation, whereas others claim that statistical sources suffice. This divergence of view again is linked to the other very important discussion of data collection: Is generic data sufficiently accurate for the assessment or must site specific investigations be employed? From a pragmatic viewpoint, a minimum criterion for the quality of the input data must be that the value of the assessment as decision support should be better than no assessment at all. If this minimum can only be reached by using site specific data, the burden of assessing even a relatively simple product can become immense and easily lead to the need for drastically narrowing the boundaries of the assessment.

In this context, it is also important to remember that the quality of site specific data is very dependent on the auditing approach and therefore not necessarily of high accuracy, and that generic data might be designed to take into account the location, sector, size and maybe ownership of a company and thereby in some cases give a reasonable impression of the social impacts that can be expected from the company performing the assessed process.

The application-dependency of the methodology seems important to address here. Differences in approaches may be explained by differences in their intended use. Thus, when addressing width, depth, and information needs in the SLCA, it is important to remember that these must be balanced according to the relevance for its users.

To sum up, it is visible that SLCA is in the stage of development where different approaches emerge, hypotheses are tested and discussed (e.g. in the UNEP-SETAC task force on Social impacts in LCA). This stage comes before the stage of consensus creation and harmonisation, and this is visible in the diversity of the approaches included in the review.

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