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Life Cycle Initiative

Guidelines for Social Life Cycle Assessment of Products

United Nations Environment Programme

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Interuniversity Research Centre for the Life Cycle of Products, Processes and Services

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Guidelines for Social Life Cycle Assessment of Products

Social and socio-economic LCA guidelines complementing environmental LCA and Life Cycle Costing, contributing to the full assessment of goods and services within the context of sustainable development

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Executive summary

The *Guidelines for Social Life Cycle Assessment of Products* provides a map, a skeleton and a flash light for stakeholders engaging in the assessment of social and socio-economic impacts of products life cycle.

First, the *S-LCA Guidelines* provides a map, which describes the context, the key concepts, the broader field in which tools and techniques are getting developed and their scope of application. The map is important because it relates to history, initiatives and ideas that are both molding the S-LCA technique and essential to its broad application.

Shared concerns about the state and sustainability of environmental, economic and social dimensions of today's and tomorrow's world are expressed through the concept of Sustainable Development. The journey towards sustainability finds sustainable production and consumption at its very heart. It also relates to the social responsibility of organizations and the objective to improve social and environmental performances along with sustained economic profitability -all in the perspective to contribute notably to greater human well-being.

Because it is holistic, systemic and rigorous, Life Cycle Assessment is the preferred tool when it comes to access information about potential and real impacts of products life cycle. Life cycles of products involve material, energy and economic flows. They are also made of stories about production and consumption impacts on the workers, the local communities, the consumers, the society and all value chain actors.

Second, the S-LCA Guidelines provides a skeleton. It presents key elements to consider and provide guidance for the goal and scope, inventory, impact assessment and interpretation phases of a social life cycle assessment. The *S-LCA Guidelines* provide the necessary basis for the development of databases and the design of softwares that will ease the practice of S-LCA. The skeleton is important because it is a foundation on which a larger group of stakeholders can engage.

The framework detailed in the *S-LCA Guidelines* is in line with the ISO 14040 and 14044 standards for Life Cycle Assessment. Adaptations for the consideration of social and socio-economic issues are described in the framework. It proposes a two-fold classification of social impacts: by stakeholder categories and impact categories. A set of subcategories, which are social and socio-economic issues of concerns, to be used in S-LCA are presented.

Third, the *S-LCA Guidelines* provide a flash light that highlights areas where further research is needed. Other publications shall follow these *Guidelines,* presenting details of the methodology and further developments notably in regard to Impact assessment. A flash light is important to enable researchers and practitioners to identify rapidly where additional efforts should be invested. It also helps to prevent the use of the technique for applications that would not be appropriate considering its current state of development such as comparative assertion communicated to the public. Further resources will be made available to the public on the UNEP/SETAC Life Cycle Initiative web site.

Social Life Cycle Assessment is a technique available to account for stories and inform systematically on impacts that otherwise would be lost in the vast and fast moving sea of our modern world. May it help stakeholders to effectively and efficiently engage to improve social and socio-economic conditions of production and consumption.

Sommaire exécutif

Les *Lignes directrices pour l'Analyse sociale du cycle de vie des produits (ASCV)* fournissent une carte, un squelette et une lampe de poche pour les parties prenantes qui s'engagent dans l'évaluation des impacts sociaux et socio-économiques du cycle de vie des produits.

Premièrement, les Lignes directrices pour l'ASCV délivrent une carte qui décrit le contexte, les concepts-clés et le champ dans lequel les outils et techniques ont été développés, et présentent leurs applications possibles. Cette carte est importante car elle retrace l'histoire, les initiatives et les idées qui ont façonné l'ASCV. La compréhension de ces composantes est essentielle pour mettre en oeuvre cette technique de manière cohérente et extensive.

Les préoccupations communes concernant l'état et la durabilité des dimensions environnementale, économique et sociale du monde d'aujourd'hui et de demain sont exprimées dans le concept de développement durable. La production et la consommation durables sont au cœur de ce concept. Il se rapporte également à la responsabilité sociale des organisations et vise à améliorer les performances sociales et environnementales à l'instar de la rentabilité économique à long terme – dans la perspective de contribuer notamment à un plus grand bien-être humain.

Holistique, systémique et rigoureuse, l'analyse du cycle de vie (ACV) est un outil privilégié pour recueillir des informations sur les impacts potentiels et réels du cycle de vie des produits. Les cycles de vie des produits sont composés de flux matériel, énergétique et économique. Ils sont également composés d'histoires témoignant des impacts de la production et de la consommation sur les travailleurs, les communautés locales, les consommateurs, la société et tous les acteurs de la chaîne de valeur.

Deuxièmement, les Lignes directrices pour l'ASCV fournissent un squelette. Elles présentent des éléments-clés à prendre en considération lors de l'utilisation de cette technique. Elles donnent également des conseils et des directives spécifiques à chacune des phases de l'étude : définition des objectifs et du champ de l'étude, analyse de l'inventaire, évaluation des impacts et, finalement, interprétation des résultats. Ces lignes directrices constituent le support nécessaire pour développer des bases de données et concevoir les logiciels qui simplifieront la pratique de l'ASCV. Le squelette est important car il représente l'armature à partir de laquelle un plus grand nombre de parties prenantes peut s'engager.

Le cadre détaillé dans les Lignes directrices pour l'ASCV est conforme aux normes ISO 14040 et 14044 pour l'analyse du cycle de vie. Les lignes directrices décrivent les adaptations nécessaires à la norme afin de permettre la prise en compte des considérations sociales et socio-économiques de façon optimale. Une double classification des impacts sociaux et socio-économiques est proposée : à la fois par catégories de parties prenantes et par catégories d'impacts. Le document présente également un ensemble de sous-catégories, illustrant des questions sociales et socio-économiques d'importance, à utiliser lors de la réalisation d'une ASCV.

Troisièmement, les Lignes directrices pour l'ASCV fournissent une lampe de poche mettant en lumière les secteurs où davantage de recherches sont nécessaires. D'autres publications suivront ces Lignes directrices, détaillant la méthodologie et faisant état des développements, notamment en terme d'évaluation des impacts. Cette lampe de poche est importante car elle permet aux chercheurs et aux praticiens d'identifier rapidement là où des efforts additionnels devraient être consentis. Elle permet également d'éviter que la technique soit utilisée à des fins non appropriées étant donné son état de développement actuel (par exemple pour une évaluation comparative des produits qui serait rendue publique). Des ressources complémentaires seront disponibles pour le public sur le site web de l'Initiative sur le Cycle de Vie du PNUE et de la SETAC.

L'Analyse sociale du cycle de vie est une technique adéquate pour rendre compte des faits vécus dans le cadre du cycle de vie des produits et pour informer systématiquement sur les impacts qui menacent d'être passés sous silence dans la mer aux flots rapides de la civilisation moderne. Nous souhaitons qu'elle aide les parties prenantes à s'engager de manière efficace et décisive pour améliorer les conditions sociales et socio-économiques de la production et de la consommation.

Resumen ejecutivo

Líneas Directrices para un Análisis de Ciclo de Vida (ACV) Social proveen de mapa, una estructura y una retrospectiva hacia el involucramiento de partes interesadas e involucradas en la evaluación social de los impactos de productos en el ciclo de vida.

En primer lugar, las Líneas Directrices para un ACV Social ofrecen un mapa que describe el contexto, los conceptos clave, las áreas adicionales en las que las herramientas y técnicas son desarrolladas, y el ámbito de aplicación de las Líneas Directrices. El mapa es importante porque hace relación a la historia, las iniciativas y las ideas que son moldeadoras de la técnica de ACV Social e indispensables para su amplia aplicación. Bajo el concepto de Desarrollo Sostenible se expresan las preocupaciones sobre el estado y la sostenibilidad de las dimensiones ambientales, económicas y sociales del mundo de hoy y del mañana. El viaje hacia la sostenibilidad considera la producción y el consumo sostenibles en el centro de sus actividades; también se refiere a la responsabilidad social de las organizaciones y al objetivo de mejorar el desempeño social y ambiental a la par de una rentabilidad económica sostenida – todo desde la perspectiva de contribuir sensiblemente a un mayor bienestar del ser humano. Por ser una herramienta holística, sistémica y rigurosa, el Análisis de Ciclo de Vida es la preferida cuando se trata de acceder a información sobre los impactos potenciales y reales del ciclo de vida de los productos. Los ciclos de vida de productos se elaboran a partir de flujos de materiales, de energía y económicos. Los ciclos de vida también se elaboran a partir de historias acerca de los impactos (reales o potenciales) de la producción y consumo en los trabajadores, las comunidades locales, los consumidores, la sociedad y todos los actores de la cadena de valor.

En segundo lugar, las Líneas Directrices para un ACV Social ofrecen una estructura. Las Líneas Directrices presentan los elementos clave a ser considerados y proporcionan orientación acerca del objetivo y ámbito de aplicación, el inventario, la evaluación del impacto y la interpretación de las fases de un Análisis de Ciclo de Vida Social. Las Líneas Directrices para un ACV Social proporcionan la base necesaria para el desarrollo de bases de datos y el diseño de softwares que facilitará la práctica de ACVs sociales. La estructura es importante porque es una base sobre la cual un grupo más amplio de partes interesadas e involucradas puede participar.

El marco detallado en las Líneas Directrices para un ACV Social está en línea con las normas ISO 14040 y 14044 para un Análisis de Ciclo de Vida. Adaptaciones de las normas a fin de integrar cuestiones sociales y socio-económicas son descritas en las Líneas Directrices. Se propone una doble clasificación de los impactos sociales: por categorías de partes interesadas e involucradas y por categorías de impacto. Se presenta una serie de subcategorías a ser utilizadas en un ACV Social, las que se refieren a cuestiones sociales y socio-económicas de preocupación. En tercer lugar, las Líneas Directrices para un ACV Social constituyen una retrospectiva que resalta las áreas donde se necesitan más investigaciones. Otras publicaciones sucederán a estas Líneas Directrices presentando detalles de la metodología y nuevos desarrollos, en particular en lo que respecta a la evaluación del impacto. Es importante una retrospectiva a fin de permitir a los investigadores y los profesionales la identificación rápida de las áreas donde deberían ser invertidos esfuerzos adicionales. También ayuda a prevenir sobre el uso de la técnica considerando su estado actual de desarrollo en casos de aplicaciones que no serían adecuadas, tal como la afirmación comparativa comunicada al público. Más recursos serán puestos a disposición del público en la página Web de la Iniciativa PNUMA/SETAC de Ciclo de Vida. El Análisis de Ciclo de Vida Social es una técnica disponible para dar cuenta de historias e informar sistemáticamente sobre los impactos que de otro modo se perderían en el mar vasto y dinámico de nuestro mundo moderno. Esta técnica podrá ayudar a partes interesadas e involucradas a participar de manera eficaz y eficiente a fin de mejorar las condiciones sociales y socio-económicas.

General public summary

It used to be that when consumers had to choose between two similar products, it was a pretty easy decision to make: just weigh the benefits of cost and quality then pick the item and brand that suited your needs. Today, the choices are many, and more difficult. Buyers are now drived to be conscious of the effects their choices have on our environment and on the local economies. Do we buy from the farm stand or the supermarket? Which choice will result in a less polluted, more sustainable globe? Perhaps even more daunting is the fact that some of our choices will have social and socio-economic effects as well, not only on workers but also on entire communities where production takes place. These social and socio-economic consequences are the primary concern of a social and socio-economic life cycle assessment (S-LCA).

Life cycle assessments, until now, have generally been used to analyze the effects that a product or process will have on the environment. Results of an LCA study will let companies know which aspects of their production are efficient, and where they can improve efficiency to reduce environmental impacts. All stages in the life cycle of the product are considered in an LCA, from the mining and extraction of its raw materials, to the shipping, right on to the landfill. Data are not only considered for the initial product, but also for the full life cycles of other materials that are used in the making of the product. Social and socio-economic life cycle assessments add extra dimensions of impact analysis, valuable information for those who seek to produce or purchase responsibly.

Take, for example, a simple cotton T-shirt. First, let's imagine that Shirtz—a hypothetical retailer—has requested an LCA of their latest product: a package of white undershirts. Shirtz Inc. wants to know how this new item will affect its environmental footprint as a corporation as well as what sort of improvements they can make to the production of the shirts that will reduce emissions and other harmful environmental outputs. Furthermore, Shirtz wants to know what sort of social and socio-economic effects these shirts will have on their workers, and on the communities where they have shirt factories. As an already established company, Shirtz is legally held to minimum benchmarks for things like workers' rights but they want to take their social responsibility further and need guidance on how to proceed. The label "Fair Trade" is limited in scope and ignores huge sections of the life cycle. While the making of their shirts may be ethical, the company wants to know if this can be true for the entire life cycle, even phases like shipping and disposal. These specifications and questions will help the analysts focus on finding data relevant to the goals of Shirtz.

Shirtz will work in cooperation with the analysts to determine what sort of data will be required to do the study. What kind of emissions to the air, water, or land will the study take into account? The list of chemicals released into nature during the production of the shirts probably numbers in the thousands, some more potent and detrimental than others. Special attention will probably be paid to outputs like carbon dioxide and other greenhouse gases. In parallel, the analysts will inform Shirtz on which phases of the life cycle of the product might have the greatest share of worker hours and furthermore, for which phases of the life cycle the social impacts may be the most important, using secondary data.

Third, the analyst will consider all the data found on the shirts, taking into account each and every piece and process involved in the making of the product, as much as can be acquired. The impacts of the gathering and shipment of raw cotton to a textile company, of refining that cotton into a fabric that can be sewn into shirts, the dyeing of the fabric, the stitching, the printing and addition of those uncomfortable tags that go on the necks of the shirts that say "Shirtz" in little red letters—each part is factored in. But this is just the first step. Analysts then need to consider the impacts of the life cycles of the red dyes, threads, and nylon label tags up until the point at which they enter the life cycle of the T-shirt itself. By the end of the study, analysts will have data that can tell Shirtz exactly how much carbon dioxide is produced for each shirt they make. As much as they can, the analysts will also try to find the information on the location where each of the inputs were made and how they were transported.

But that is just the easy part. Environmental impacts are much more easily standardized and quantified than social and socio-economic ones, for obvious reasons. Things like emissions can be readily measured and given numerical data that can be used over and over. For example, life cycle analysts can access data that will tell them the emissions of a freight truck. All that is left is for Shirtz to let them know how far they ship their product.

However, S-LCAs are surely as important as environmental ones. That being said, how can we proceed to conduct a S-LCA? How do we collect the data? How can we begin to assess and measure the social effects of a T-shirt? How do we assign a result or a number to the working conditions in shirt factories, or the ways in which a shirt factory affects the residents of a small community? How do we define a socially responsible company or practice? How do we bring the results for every phases of the life cycle together? These are the questions asked and to which these guidelines for social life cycle assessment of products bring relevant answers.

One core issue with S-LCA is keeping consistency among the standards between studies. Even if standards can eventually become more or less similar in criteria, differences among studies will always occur. Generally, practitioners of S-LCA will need to incorporate a large share of qualitative data, since numeric information will be less capable of addressing the issues at hand. When numeric data is useful—for example, in assessing the wages of a particular enterprise—additional data will still be needed to address its meaning: compliance with minimum wage laws does not always mean the wages are livable. Often, data may have to be collected on the spot, since databases for specific social and socio-economic impacts are at a minimum.

As one might guess, the current limitations of S-LCA are many. They can be expensive, if extensive data gathering is required. They are challenging to conduct because qualitative data is often subjective and therefore must be handled by capable experts. As with environmental LCAs (E-LCA), the ripple effects in the life cycle of the product are difficult to determine. It is hard to see where the effects of social interaction finally diminish. Since the scope of the studies is quite large, it is impossible to truly assess the *entire* life cycle. A T-shirt is a complex product with many inputs from different places. Dyes, fabrics, threads, and all their separate parts—they all have their own intricate life cycles full of inputs of their own. Without declaring boundaries, deciding where the inputs become negligible, the studies would be near impossible. The same is true for S-LCA. Furthermore, since social LCAs are almost always requested by companies and not those employed by them, they may not always have the best interests of the socially affected people at heart.

Still, while the difficulties of conducting a S-LCA are indeed many, at the end of the study, Shirtz will have a wealth of invaluable information. The company will be able to know, in terms of labor, the share of its entire life cycle worker hours that possesses a range of attributes. How much of this labor is child labour free? Do Shirtz's practices—and the practices of all its T-shirt inputs—comply with, exceed, or fail to meet standards for human rights, working conditions, health and safety, and socio-economic repercussions? The study will provide detailed answers. Shirtz will be able to communicate this information to its retailers and consumers via reports, web interface, or by putting tags on its products. The information collected will help the enterprise work to improve its social performances on key issues or in problem areas that have been identified in the study as needing improvement. It will also start dialogue for improvement in the supply chains. Shirtz will now know much more in depth the social impacts of its T-shirt, from cradle to grave.

But what Shirtz actually does with this information brings up the question of corporate social responsibility, or CSR. What sort of obligations do corporations have towards customers, communities, employees, or suppliers? Current CSR definitions and theories hold that companies should, at the very least, be held to international standards of human and workers' rights, and that they should consider environmental output regulations when making corporate decisions. Still, implementation of CSR is relatively new and poses complex challenges. How can we hold companies to a standard of ethical decision-making? How can we give motivated companies the opportunity and tools with which to productively exceed the current standards of CSR?

As further research will be conducted in the field of CSR and S-LCA, and further negotiation occurs among countries and with their companies, it may be possible to obtain more precise guidance on socially acceptable production methods, and to provide recommendations for setting system boundaries. There is also a great need for better databases of social and socio-economic information as well as the development of software tools that will speed up the process and help analysts conduct the studies. There is a need for ways for anyone—consumer, worker, citizen—to obtain information on a product's life cycle impacts and therefore, a company's production methods.

But in the end, if companies are not held responsible by their consumers, these questions of social responsibility are difficult to answer. Inevitably, the accountability lies with the people who will be wearing the T-shirts and their desire to support a socially responsible corporation.

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Foreword by UNEP

"Environment for Development" underlines UNEP's vision of sustainability. It inspires, informs, and enables governments and people to improve their quality of life without compromising that of future generations.

Together with sustainability, environment for development becomes more relevant in the current context of financial and economic crisis. In this context, UNEP is promoting a Global Green New Deal (GGND) as part of the wider Green Economy initiative to catalyze a renewed political engagement towards resource efficient markets that meet multiple challenges while fostering new green jobs and reducing poverty.

The internalization of environmental and social externalities must be part of this "New Green Deal", taking into consideration the "Triple Bottom Line" (TBL): society, environment and economy.

This publication aims at contributing to address this integrated approach. Products have both environmental and wide-ranging social impacts not only within the physical scope of their manufacturing processes but over the entire life cycle, from cradle to grave.

Along with the corporate social responsibility debate over the last two decades, there has been growing demand for direction and guidance on incorporating social issues into sustainability strategies and impact assessments. Organizations have begun to implement principles and systems recommended by international initiatives such as the United Nations Global Compact and Social Accountability International.

Aspects of measurement have also been driven by new indicators formulated under the Global Reporting Initiative, which UNEP co-launched in the late 1990s. Guidelines for Life Cycle Assessment: A "Code of Practice", published by SETAC in 1993, laid the foundation for further development to the practice of environmental Life Cycle Assessments (E-LCA), enabling us to reach the current state of E-LCA practice.

In 2006 life cycle experts acknowledged the necessity to offer a complementary tool to assess product's *social* life cycle aspects. This publication is a UNEP contribution in what is an emerging field.

The proposed code is the first international voluntary guidance document to assess social impacts along the life cycle of products in a global context. It provides an analysis and description of the current practice of social Life Cycle Assessment (S-LCA) as well as a methodology and suggests social impact categories linked to key stakeholders groups such as workers, consumers and local communities.

S-LCA does not provide information on the question of whether a product should be produced or not – although information obtained may offer useful "food for thought" before taking a decision.

This publication will help decision makers to better understand and track the implications of the consumption and production of products over their life cycle in terms of impacts on the quality of work and life of people in both developed and developing economies.

It supports the improvement of social performance – especially in societies where social systems are more fragile. We encourage both newcomers and more experienced practitioners world-wide to take it up, use it and hope that it a stimulus for continued development and application of social Life Cycle Assessment.

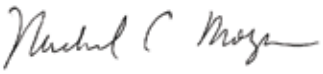
Achim Steiner
UN Under-Secretary General and
Executive Director, United Nations Environment Programme

Foreword by SETAC

The world in the 21st century faces daunting environmental challenges. And it confronts the continuing need to promote political and economic development and a better life for a growing population. Since 2002, the UNEP/SETAC Life Cycle Initiative has provided an umbrella for important work on the environmental dimension of economic development, with activities encompassing a range of life cycle disciplines. Life Cycle Assessment and Management are perhaps the leading areas of work, but the scope of research and discussion is constantly broadening. This expanded scope is consistent with the Initiative's strategic goal of facilitating the "incorporation of Life Cycle Thinking and the social, economic and environmental aspects of sustainability into management."

This document describing possible Guidelines for a Social Life Cycle Assessment comes out of this broader discussion and is the result of several years of collaboration among an impressive group of life cycle experts. The document sets out the larger challenge and, in the process, establishes a framework for addressing crucial social aspects. It is consistent with the broader debate on global sustainable development and focuses on key social elements related to economic activity and production. This discussion is timely as businesses large and small around the globe seek to establish clear and positive records on their corporate social responsibility (CSR).

As you will see, important work has been done to tackle the issues related to social life cycle assessments. But much more is needed to bring the approach and its related tools to maturity and to mainstream use. I hope that the reader of this valuable analysis and guidelines document will be encouraged to examine the issues more closely. Moreover, I hope that they will join the experts, business decision makers, and governments in working together to develop the social life cycle concept and practices still further and to achieve a positive impact to the benefit and greater welfare of the world's growing population.



Michael Mozur
Global Executive Director
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Abbreviations

10YFP: 10 Year Framework of Programmes
AA: Account Ability
ADB: Asian Development Bank
CERES: Coalition for Environmentally Responsible Economies
CSD: Commission on Sustainable Development
CSR: Corporate Social Responsibility
ECOSOC: Economic and Social Council
FSC: Forest Stewardship Council
GC: Global Compact
GRI: Global Reporting Initiative
HIA: Health Impact Assessment
HRIA: Health and Risk Impact Assessment
ICC: International Chamber of Commerce
IGO: Intergovernmental Organization
IIED: International Institute for Environment and Development
IMF: International Monetary Fund
ILO: International Labour Organization
ISO: International Organization for Standardization
IUCN: International Union for the Conservation of Nature
LCA, E-LCA, S-LCA: Life Cycle Assessment; environmental LCA; social and socio-economic LCA
LCI: Life Cycle Inventory
LCIA: Life Cycle Impact Assessment
LCM: Life Cycle Management
NGO: Non-Governmental Organization
OECD: Organization for Economic Co-operation and Development
SA: Social Auditing
SCP: Sustainable Consumption and Production
SETAC: Society of Environmental Toxicology and Chemistry
SEA: Strategic Environmental Assessment
SIA: Social Impact Assessment
SIGMA: Sustainability-Integrated Guidelines for Management
SiRi: Sustainable Investment Research International
TBL: Triple Bottom Line
UN: United Nations
UN-DESA: United Nations - Department of Economic and Social Affairs
UNCED: United Nations Conference on Environment and Development
UNEP: United Nations Environment Programme
UNEP-DTIE: United Nations Environment Programme – Division of Technology, Industry and Economics
USAID: United States Agency for International Development
WB: World Bank
WBCSD: World Business Council for Sustainable Development
WCED: World Commission on Environment and Development
WSSD: World Summit on Sustainable Development
WWF: WorldWide Fund for Nature

1. Introduction

The ultimate goal of sustainable development is human well-being, contributing to the needs of current and future generations. Each and every operationalization through – inter alia – a policy instrument or an enterprise strategy, supported by methodologies, techniques and tools, which can contribute to this objective, is highly recommended.

In the field of product and process assessment, some methodologies, techniques and tools have been developed, mostly supporting policies and strategies for the social, economic, or the environmental dimension of sustainable development. In recent years several efforts have been pursued to cover, in a more coherent and integrated way, all pillars of sustainable development. It is within this context that these guidelines should be perceived.

> *Consumers are asking themselves questions about the social and economic circumstances under which a product is made. Enterprises do not want to be linked to "child labor" or "corruption," neither within their organization, nor in their supply chain. Trade unions want to show solidarity with their fellow workers. Public authorities need to apply the integrated product policy in place, for example for their public procurement, etc. How can these stakeholders know that the particular goods and services are produced in a sustainable way?*

When considering products and services in a sustainable development perspective, a life cycle perspective brings powerful insights. It aims to provide increased knowledge on the 3P's -- the three pillar approach of sustainable development: People, Planet, and Profit/Prosperity -- along the whole supply chain, from extraction of raw material to end of life. This is all meant to inform more comprehensive decision-making.

Figure 1 shows a matrix illustrating the distinction between private costs and externalities and reflecting what is at stake when assessing goods and services within the context of sustainable development. An externality occurs when a decision within the value chain imposes costs or benefits on others which are not reflected in the prices charged for the goods and services being provided by the value chain. Externalities are sometimes referred to as spillovers. An externality may also result in private costs, even though it might not be accounted for in the decision-making.

Two tools have been developed to assess parts of this framework. The most famous is Environmental Life Cycle Assessment (E-LCA), a very popular tool used to provide information on the externalities and internalities for the planet (green part of Figure 1). In other words, it is mainly looking at the impacts on the natural environment of economic activities and, to a minor extent, impacts on human health and natural resources. A rather new tool is Life Cycle Costing (LCC): see blue part of Figure 1. This tool is primarily focused on the direct costs and benefits from economic activities for "people, planet and profit or prosperity."

Until now, no commonly accepted methodology for assessing internalities and externalities of the production of goods and services for "people" and "profit/prosperity" was available. That is precisely what the tool presented in these Guidelines wants to deliver (see red part of Figure 1): on the basis of the most current and state of the art methodological developments it formulates guidelines on how to assess a product based on social and socio-economic indicators[1]. By doing so, it is complementing the E-LCA and the LCC in contributing to the full assessment of goods and services within the context of sustainable development.[2] In the text, social LCA will be used as a synonym for social and socio-economic LCA and S-LCA will be used as an acronym.

1 Note: it will be made clear that there is a similarity with GRI and ISO 26 000.

2 Sustainability assessment may also require the evaluation of other components that E-LCA, LCC and S-LCA may not able to include.

	People	Planet	Profit/Prosperity
Internalities (Costs and benefits)	E.g. health and safety expenditures.	E.g. costs for pollution prevention.	E.g. costs of raw materials, taxes, interest on capital.
Externalities (Costs and benefits)	E.g. impacts on human well-being due to social impacts	E.g. biodiversity or human health impacts from pollution	E.g. reduction in crop yields due to pollution

Figure 1 – Detailing the full assessment of goods and services within the context of sustainable development

It was chosen to entitle this document "guidelines" in reference to the 1993 Guidelines for Life-Cycle Assessment: A 'Code of Practice', published by SETAC. The 1993 Guidelines were produced because "a need became apparent for a harmonized approach and for consistent methodologies" (Posdethwaite, 1994). Indeed the role of the E-LCA code of practice in harmonizing the practice and making possible the development of databases and the creation of software is widely recognized. It was acknowledged in 1994 that the Life-Cycle Assessment code of practice represented the current state of the art and that subsequent updates would be necessary to include developments in the methodology. The same hold true for the social LCA guidelines. In that context, we can define this document as being voluntary guidelines published by a public body that details shared understandings among practitioners about how to conduct a social LCA.

Box 1

Historical background

The discussion on how to deal with social and socio-economic criteria in Life Cycle Assessment started about fifteen years ago, with the publication of the SETAC Workshop Report: "A Conceptual Framework for Life Cycle Impact Assessment" (Fava J. et al., 1993). In this report a "social welfare impact category" was proposed by stating, inter alia, *"… the primary emphasis should be on environmental impacts that arise directly or indirectly from other social impacts …."* The proposed social impact category helped begin a more comprehensive discussion among LCA methodology developers.[3]

During the second half of the nineties, researchers discussed – sometimes in a multidisciplinary environment in which social scientists were working together with (applied) natural scientists – if "life cycle assessment" of a product or a service taking into account social criteria is different from the usual environmental LCA. Several points were raised: What about the system boundaries? Are there issues raised by translating criteria into impacts? Does a LCA really need to limit itself to social (and economic) impacts directly or indirectly influencing other environmental impacts? Shouldn't the social criteria be linked to international agreements? What about the interdependency between the environmental, social and economic criteria when assessing a product or a service?

At the beginning of this century, some research groups presented their methodologies for cradle to grave assessment of goods and services with social criteria. Some of these methodologies were branded as "S-LCA" studies. In some of the methodologies the "s" was indeed referring to "social," while others were going a step further by presenting a "sustainability LCA."

3 See e.g. Mazijn (1994a)

At the same time, similar exercises were being undertaken in parallel with the "LCA world's" research. As a result, several social assessment tools were developed. Chapter 2 of these Guidelines outlines some of them in more detail. Other authors, in addition to the authors of this document, already envisioned the need to address the social dimension in life cycle tools to be developed (Brent A. and Labuschagne C., 2006; Jørgensen A, et. al., 2008; Hunkeler R, et. al., 2005; Hutchins and Sutherland, 2008; Dreyer L, et. al., 2006; Brent A, et al., 2006; Klöpffer W., 2003; O'Brian M, et. al., 1996). Proposed approaches were studied and discussed when developing the methodology proposed in this document.

By the end of 2003, the UNEP/SETAC Life Cycle Initiative recognized a need for a Task Force on the integration of social criteria into LCA.

It was motivated by a consensus that *"the use of LCA is hampered in developing countries [economies][4] clearly due to lack of expertise, data etc., but also due to the inability of LCA to engage in developing countries key issues." Negative perceptions of LCA in developing countries include:*

1. *LCA can be considered to be 'anti-development'-orientated because it provides only a picture of negative environmental consequences, but does not reflect any of the positive aspects of development, i.e. social and economic benefits.*
2. *Even if the value of LCA is appreciated, a justification for the high costs is lacking since it does not address the developing countries' most significant concerns, i.e. poverty eradication together with other social aspects such as employment rates, wages, accidents, working conditions and human rights."*[5]

In the Terms of Reference of the Task Force the aims were expressed as follows:

- *"to convert the current environmental tool LCA into a triple-bottom-line sustainable development tool,*
- *to establish a framework for the inclusion of socio-economic benefits into LCA,*
- *to determine the implications for LCI analysis,*
- *to determine the implications for LCIA,*
- *to provide an international forum for the sharing of experiences with the integration of social aspects into LCA."*[6]

A Working Group chairman was selected, members were invited, and work began. The first meeting was held in Prague, back-to-back with the annual SETAC Europe conference (April 2004). At each meeting, methodological issues (including indicators) and case-studies were discussed. The first deliverable was the publication of the feasibility study in May 2006 (Griesshammer R. et al., 2006) which concluded: *"In terms of methodology, there are evidently no fundamental problems calling the feasibility of S-LCA into question."* However, it was clear at that time that a lot of work needed to be done before a Guidelines could be published. In 2007 the name of the Working Group changed to Project Group (PG) on S-LCA.

More than ten meetings, workshops and seminars were organized: see Annex 1a. Twelve organizations representing key stakeholders in the field of Social responsibility met to collect feedback on the S-LCA guidelines and the PG work, (see Annex 1b) and an international peer review was organized by UNEP and SETAC. Thirty-nine key experts were contacted to review these guidelines. Among them, seventeen experts in the field of social responsibility, sustainability and life cycle assessment engaged actively in the process and formulated important comments which were all addressed and integrated in the code of practice. The PG formulated responses to all the reviewers' comments. In addition, as part of funding requirements, two consultations were organized in Quebec, Canada, involving forty-six selected social and environmental responsibility local experts. Their comments were also addressed and integrated in the document. The Project Group will continue with its work, but these Guidelines represent a major milestone. They are intended to offer an adequate foundation from which a larger group of stakeholders can engage to move towards a "sustainability LCA."

4 The term developing economies is now the term used in UNEP official publications.
5 See **http://lcinitiative.unep.fr**
6 Ibid.

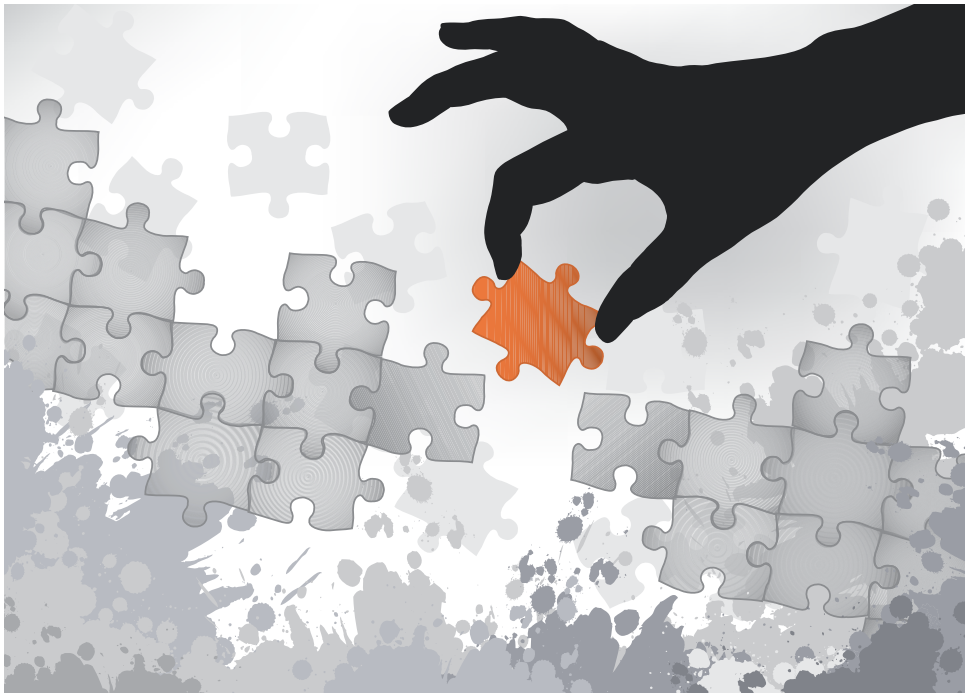
2. Elements of Context

It is not a new observation that nearly every society is supported by an environmental[7], a social and an economic pillar.[8] The interconnection among the three pillars has been emphasized over the last decades. Several analyses also refer to the political and/or cultural dimension of a society. Within the context of these Guidelines it is not possible to go into an in-depth review. In summary, we may say "A society is developing **socially** and **economically** within an **environmentally** conditioned context. This development is directed by a way of **political** organization. And at a certain place on Earth, in a particular period, the society is held together by its own **cultural** characteristics" (Mazijn, 1994b). All underlined aspects are – at least – of some importance for the functioning of the society.

In today's society, the current level of awareness of the interconnection among these different aspects is not adequate for optimal decision-making. Much too often, decisions are made based only on political and/or economic considerations without taking into account the environmental or social criteria and cultural differences.

And yet, for some time now, methodological frameworks have been developed by scientists to measure changes or evolutions in (parts of) the society[9] in a holistic and integrated way. During the last two decades, those frameworks have been placed within the context of sustainable development."[10]

This chapter reviews the context and concepts within which a S-LCA is developed and applied, including the following concepts: sustainable development, human well-being, sustainable consumption and production, corporate social responsibility, life cycle thinking and related techniques for product and process assessment.



7 In this document the term environmental is used in its narrow sense, to indicate the biophysical environment, not including the social and economic environment.

8 This does not hold for all (e.g. indigenous) societies and might not be the case for future societies.

9 "Parts of society" refers to e.g. cities, economic sectors, protected national parks …

10 Notice: for sustainable development the concept of sustainability is often used as a synonym. In these "Guidelines" both concepts will be used as synonyms.

2.1. Sustainable Development

In 1987, the World Commission on Environment and Development (WCED) chaired by Norwegian Prime Minister, Mrs. Gro Harlem Brundtland, published "Our Common Future." From that moment on, the term sustainable development stood at the core of the debate on environment and development. It was described as "… a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development and the institutional change are made consistent with future as well as present needs" (WCED, 1987). The notion of sustainable development had already been mentioned several years earlier, in 1980, when the International Union for the Conservation of Nature (IUCN), the World Wide Fund for Nature (WWF), and the United Nations Environmental Programme (UNEP) published the "World Conservation Strategy"[11] and coined the term sustainable development. In 1991 this report was updated through a document called "Caring for the Earth", published by the same international organizations[12].

The concept of sustainable development did put forward the complex problem of allocation: "How can an equitable welfare for everyone be created without exhaustion or degradation of natural resources or ecosystems?" It was meant to become an overarching principle for all human actions. After the publication of "Our Common Future," the question of allocation became the focus of the important United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro (1992)[13] when discussing Agenda 21[14] and in particular climate change, biodiversity, and forests.

This issue was already put forward by the Brundtland commission in their definition of sustainable development: "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own" (WCED, 1987). The definition contains two key concepts:

- "The concept of needs, in particular the essential needs of the world's poor, to which overriding priority should be given; and
- The idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs."

Today, this definition is still valid. It is clear that within this "solidarity concept in space and time" (the needs of the present and future generations), environment and development are playing a crucial role. This is precisely the reason why these Guidelines aims at complementing the E-LCA-methodology (the environmental Life Cycle Assessment methodology with is mainly biophysical focus).

> *As mentioned before, methodological frameworks have been developed by scientists to measure changes or evolutions in (parts of) the society in a holistic and integrated way. The Brundtland definition regarding sustainable development has, at times, been viewed as being vague or incomplete. During the last two decades, dozens of other definitions – sometimes targeting particular stakeholders, sectors, levels of decision-making, etc. – have been published. Some were trying to operationalize sustainable development for their own purpose, while others tried to reorient the internationally agreed direction for their own sake. Again, it cannot be the aim of the Guidelines to give an in-depth review of all these definitions, but it is worth mentioning some of those that have acquired international support.*

11 IUCN, UNEP and WWF (1980)
12 IUCN, UNEP and WWF (1991)
13 UNCED (1992b)
14 Agenda 21 is a comprehensive plan of action to be taken globally, nationally and locally by organizations of the United Nations System, Governments, and major groups in every area in which there are human impacts on the environment.

The "Guidelines for a S-LCA" will affect business directly and indirectly[15], and it is instructive to examine the position of international stakeholder groups and initiatives including the International Chamber of Commerce (ICC), the World Business Council for Sustainable Development (WBCSD), the Global Reporting Initiative (GRI), and the UN Global Compact. None of these groups or initiatives defines their own version of sustainable development. In fact, the WBCSD, for example, explicitly refers to the Brundtland definition.

Within the context of corporate social responsibility, the concept of Triple Bottom Line (TBL) was launched by John Elkington. He described the concept as follows: "Triple Bottom Line accounting attempts to describe the social and environmental impact of an organization's activities, in a measurable way, to its economic performance in order to show improvement or to make evaluation more in-depth" (Elkington, 1998). The TBL is understood as similar to the 3P approach: People, Planet, and Profit.

While people and planet imply a collective interest, profit can be interpreted as self-interest. Therefore, it is not surprising that the World Summit on Sustainable Development, held in Johannesburg (2002) and organized in order to assess progress on the UNCED commitments, was rather referring to "People, Planet, and Prosperity.*"*

In conclusion, it is clear that Sustainability Life Cycle Assessment, as a technique for measuring changes or evolutions in society (from the perspective of goods and services), will need to take into account environmental, social and economic criteria in its assessment. It is only then that it can contribute to sustainable consumption and production patterns.

15 It is clear that these Guidelines will affect all sectors of society, including governments, business, civil society, etc.

2.2. Human Well-Being

Because the ultimate goal of a S-LCA technique is to promote improvement of social conditions throughout the life cycle of a product, human well-being is a central concept that needs to be defined and articulated.

The history of attempts to identify the basic needs required to support human well-being is at least as old as Aristotle. Many different conceptualizations of well-being co-exist but as summarized by Marc McGillivray (2007), many authors have pointed that the term is "a concept or abstraction used to refer to whatever is assessed in an evaluation of a person's life situation or 'being'." It is a description of the state of an individual's life situation.

Many terms are used, sometimes interchangeably, to refer to human well-being. The most common are quality of life, living standards and human development, but the following terms can also be used: welfare, life satisfaction, basic human needs fulfillment, human development, happiness and utility.

Some of the prominent threads of work attempting to relate basic needs to economic development (Sen,1993 in Nussbaum,1998) build explicitly upon the Aristotelian framework. Well-being is a multidimensional concept. The dimensions are diverse and cover aspects ranging from knowledge, friendship, self-expression, affiliation, bodily integrity, health, economic security, freedom, affection, wealth and leisure (Alkire, 2002).

McGillivray (2007) presents Finnis's (1980) conception that well-being dimensions are: (1) self evident, in that they are potentially recognizable by anyone; (2) incommensurable, in the sense that all of the desirable qualities of one are not present in the other; (3) irreducible, as there is no one denominator to which they can be totally reduced; and (4) non-hierarchical, since at any point in time any one dimension can seem to be the most important (Alkire 2002).

Sen and Nussbaum propose to characterize the access to basic needs as necessary "capabilities to function." Nussbaum (1998) proposes a set of basic capabilities to function which is intended to be universally applicable across cultures. Within the field of psychology, Maslow (1954), and more recently, Max-Neef (1992) have proposed sets of basic human needs. Deci (1995) and colleagues have identified three basic psychological needs that are evidenced empirically across cultures, age, gender, and economic status: those they label autonomy, competence, and relatedness. Human needs are not seen as well-being itself but rather as preconditions of well-being (Alkire, 2002).

The Millennium Ecosystem Assessment (MA) assessed the consequences of ecosystem change for human well-being, stating it is at the opposite end of a continuum from poverty, which has been defined as a "pronounced deprivation in well-being." It proposed a definition of human well-being which includes multiple constituents, basic material for a good life, freedom and choice, health, good social relations, and security. This statement goes beyond a definition based on quantity of material consumption and production, to include qualitative improvement and multiple paths. Many renowned authors, such as Jerome M. Segal (1999), argue that the current Occidental standards of living are not generating more human well-being and that we greatly need to move from an approach based on quantity of material to an approach based on quality of life. Guliz Ger (1997) argues that well-being involves both cultural and natural ecology and is based on utilizing the specific resources (nonmaterial resources, e.g., intelligence, imagination, history, cultural heritage) of each locality—self-reliance. It involves active reversing of environmental and cultural degradation and nourishing of both natural and cultural ecological diversity.

There is also such a thing as not enough. Without a minimum level of the basic physical necessities to life such as food, water, shelter, clothing and security, the human body will perish. Without a minimum level of opportunity and freedom, without opportunities to meet basic psychological needs for autonomy, competence, and relatedness (Deci, 1995), the body may survive while the human spirit withers within.

The ability to voluntarily avail oneself of the basic physical, economic, political, civil and cultural necessities of life has come during the 20th century to be understood as a universal and indivisible human right: the right to development (Sengupta, 2000). In that context, a multilateral initiative which has the goal to reverse the grinding poverty, hunger and disease affecting billions of people was initiated: The Millenium Development Goals (MDGs). The MDGs are a set of eight goals that range from halving extreme poverty to halting the spread of HIV/AIDS and providing universal primary education, all by the target date of 2015. These goals form a blueprint agreed to by all the world's countries and all the world's leading development institutions. They have galvanized efforts to meet the needs of the world's poorest.

Article 25 of the 1948 Universal Declaration of Human Rights identified the right to an adequate standard of living as a universal human right. Article 11 of the International Covenant on Economic, Social and Cultural Rights of 1966, which has the status of an international treaty, reaffirmed these rights. The Treaty Body was established to monitor and interpret the implications of this covenant and has further elaborated their meaning. For example, it defines the right of everyone to the enjoyment of just and favorable conditions of work (UN, 1994 in Sengupta, 2000).

From this, it becomes clear that in the light of the human right to development, sustainable consumption and production, which are the goals of LCA-based decision-making, are tightly interlinked. This inter-linkage occurs in both directions, as consumption drives the chains of production of goods and services, and when production activities provide the economic opportunities that in turn enable the free capability of consumption.

2.3. Sustainable Consumption and Production

Without labeling it as such, the United Nations Conference on the Human Environment (1972, Stockholm) had already underlined the unsustainable trends within our society due to "man's capability to transform his surroundings" by referring to "incalculable harm to human beings and the human environment."[16]

Twenty years later (1992), the warning was explicitly reiterated in the Rio Declaration on Environment and Development: "To achieve sustainable development and a higher quality of life for all people, States should reduce and eliminate unsustainable patterns of production and consumption and promote appropriate demographic policies."[17] Agenda 21 dedicated Chapter 4 to the different aspects of "Changing consumption patterns", focusing on production and consumption.

However, during the nineties, production and consumption were often addressed separately. It was the era of cleaner production and sustainable consumption. It was as if supply and demand were not seen as interlinked. Pioneers trying to push forward sustainable consumption and production as a cross-cutting issue in many sectors had a difficult time.

It was not until the World Summit on Sustainable Development (WSSD) in 2002 that the international community – as part of the Johannesburg Plan of Implementation – launched a 10-year Framework of Programmes (10YFP) on Sustainable Consumption and Production (SCP). One year later, the 10YFP became the Marrakech Process, leading the international community to an overall review. This review was followed by a negotiation on an enforced policy formulation at the UN Commission on Sustainable Development in 2010-2011.

UNEP-DTIE and UN-DESA are the lead agencies of this global process, with an active participation of national governments, development agencies, and civil society. As they point out: "Sustainable Consumption and Production is working at promoting sustainable resource management in a life cycle perspective for goods and services produced and used by governments, business and civil society."

More recently the European commission presented an *Action plan on sustainable production and consumption and sustainable industrial policy* (European Commission, 2008) in which the role of life cycle methodologies for sustainable production and consumption is emphasized.

While it may be clear that supply and demand are interconnected, it is still common practice to look at SCP from different angles. Hereafter, the enterprise-oriented ("corporate social responsibility") and product-oriented ("life cycle management") point of view will be addressed.

16 Principle 3 in the Declaration of the United Nations Conference on the Human Environment (1972, Stockholm).

17 Principle 8 in the Declaration of the United Nations Conference on Environment and Development (1992, Rio de Janeiro).

2.4. Corporate Social Responsibility

Corporate social responsibility (CSR) refers to the responsibility enterprises can assume in order to contribute to sustainable development. Public authorities, through policy-making, and the private sector, through business strategies, can guide the management and the production processes of enterprises towards CSR. However, it is debated whether CSR should address solely voluntary initiatives to go beyond regulations (i.e. norms and compliance) or should also be subject to regulatory measures. It is clear that CSR has the enterprise as its focus although the importance of the supply chains is increasingly recognized and added, in variable manners, to the scope of what enterprises do for/about CSR (cf. 2.4. Life Cycle Thinking).

> *The history of social and environmental concerns about business is as old as trade and business itself. The Brass centre shows that commercial logging operations and laws to protect forests can both be traced back almost 5,000 years (BRASS Centre, 2007). Circa 1700 BC, King Hammurabi of Ancient Mesopotamia is known to have introduced a code which included provisions according to which builders, innkeepers or farmers were put to death if their negligence caused the deaths of others or major inconvenience to local citizens. The practice of business and trade has a long history and was always subject to cultural and moral norms. Evidence of this can be found in biblical text, oral history and mythology of ancient civilizations and indigenous societies. In the 18th century, Adam Smith himself, best known for his work on* The Wealth of Nations, *is considered to have seen the centrality of ethics to business (Werhane, 1991).*

The modern history of CSR often refers to the book *Social responsibilities of the businessman* (Bowen H.R, 1953) as being a starting point for the current debate and movement. While the concept first originated in the mid 20th Century, it took another 50 years for it to gain widespread attention. During the past decades, different authors contributed to the evolution of the concept and its operationalization. Edward Freeman (1984), for instance, has contributed greatly to the development of the stakeholder theory, which is intimately connected to CSR. The stakeholder theory is a body of research which has emerged in the last 20 years through scholars in management, business and society, and business ethics in which the idea of stakeholders plays a crucial role (Jones, Wicks and Freeman, 2002).

Two basic premises are argued by stakeholder theorists:

1) To perform well, managers need to pay attention to a wide array of stakeholders (e.g. environmental lobbyists, the local community, competitors).
2) Managers have obligation towards stakeholders which include, but extend beyond, shareholders.

The model illustrated in figure 1 is generally considered as adequately descriptive of firm-stakeholder relationships.

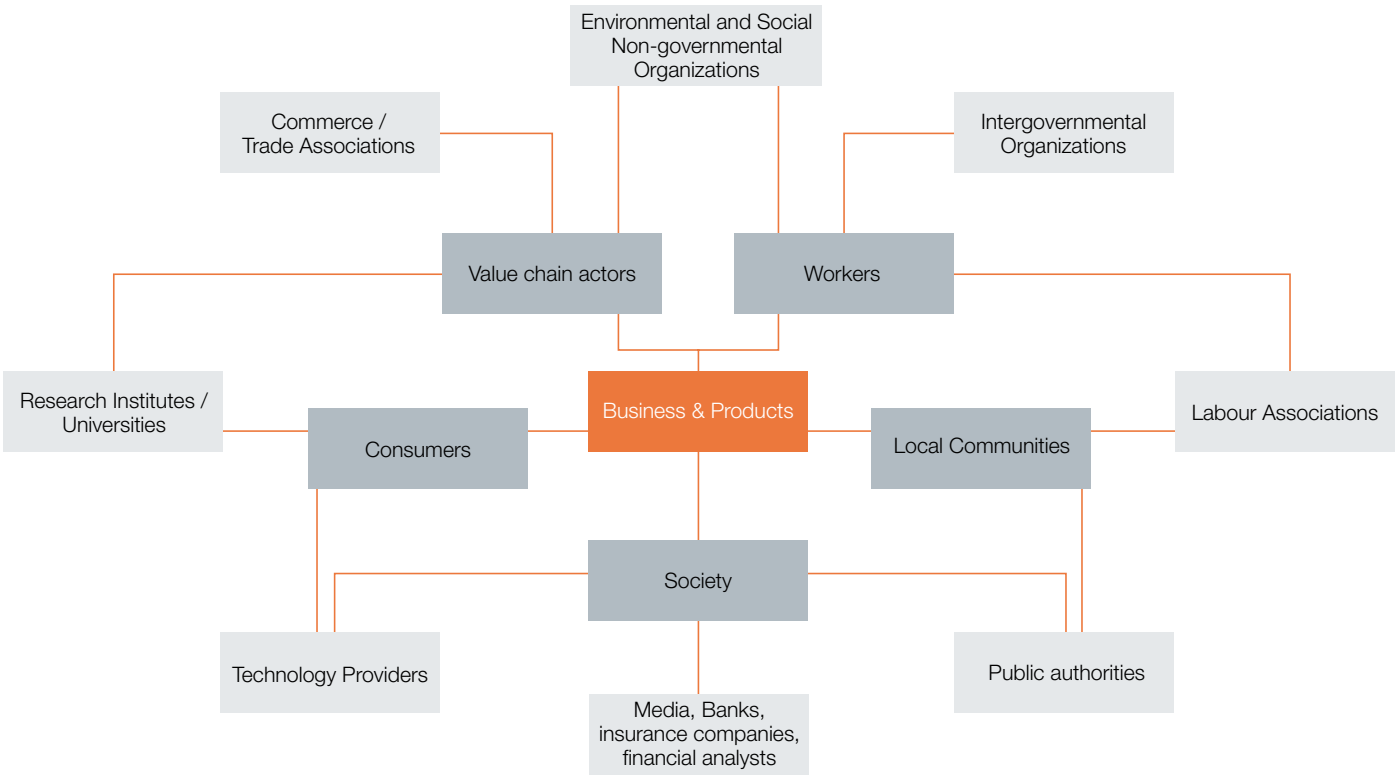


Figure 2 – Hub and spoke stakeholder diagram

In addition, it is also worth mentioning the social contract theory which is sometimes perceived as a theoretical ground for CSR. Social Contract Theory is the view that people's moral and/or political obligations are dependent upon a contract or agreement between them to form society. John Rawls is one of the most contemporary philosophers who offer a perspective on the theory which can be found in his book, *Theory of Justice* (Rawl, 1971). Furthermore, the notion of transparency (or the need for an organization to provide information and report on non-financial aspects), the notion of accountability (responsibility and liability), advancements on corporate governance (decision making processes, consistent management and cohesive policies) and, in the context of globalization, corporate citizenship (the notion that enterprises must not only be engaged with stakeholders but be stakeholders themselves alongside governments and civil society) are contributing to shape current definitions of CSR.

> *Several definitions of CSR coexist (Dahlsrud, 2007). The most quoted definition of CSR is that coined by the European Commission, which reads as follows: "A concept where-by enterprises integrate social and environmental concerns in their business operations and in their interaction with their stakeholders on a voluntary basis. (EU-Communication, July 2002)"*
>
> *The World Business Council for Sustainable Development also provides a definition that is often cited: "Corporate social responsibility is the continuing commitment by business to contribute to economic development while improving the quality of life of the workforce and their families as well as of the community and society at large."*
>
> *UNEP uses the following definition of CSR, as mentioned in the* Global Compact Environmental Principles Training package *(2005): "A values-based way of conducting business in a manner that advances sustainable development, seeking positive impact between business operations and society, aware of the close interrelation between business and society as well as of enterprises, like citizens, having basic rights and duties wherever they operate."*

A new definition that has the potential to become very popular is the one proposed in the forthcoming ISO 26000 Guidelines on Social Responsibility that reads as follows[18]:

"Responsibility of an organization for the impacts of its decisions and activities[19] on society and the environment, through transparent and ethical behaviour that

- *contributes to sustainable development, including health and the welfare of society;*
- *takes into account the expectations of stakeholders;*
- *is in compliance with applicable law and consistent with international norms of behaviour; and*
- *is integrated throughout the organization and practiced in its relationships[20]."*

Reflecting upon the four definitions presented, it is important to mention that there is no international consensus on what the content of CSR should be. One primary reason for this lack of consensus is that there are regional differences in the interpretation of CSR.[21] There are, however, some distinguishable trends:

- *a general support for and reference to the international human rights and workers rights;*
- *the importance for enterprises to consider and to engage with their different groups of stakeholders;*
- *the inclusion of environmental aspects in the CSR definition together with economic aspects.*

Corporate social responsibility comprises a broad set of initiatives and techniques. Despite their different foci, they can be categorized into six main categories: Responsibility and monitoring frameworks, Financial SR indexes, International Conventions and the Millennium Development Goals, Principles, Guidelines, Standards and norms. In section 2.4, some of the techniques will be discussed. Think tanks, consulting and audit firms also have a considerable influence in shaping CSR.

Three international initiatives greatly contribute to the CSR movement:

- The Global Compact is a CSR initiative started in 1999 by Kofi Annan, former Secretary-General of the United Nations. The Compact is "a framework for businesses that are committed to aligning their operations and strategies with ten universally accepted principles in the areas of human rights, labour, the environment and anti-corruption. As the world's largest, global corporate citizenship initiative, the Global Compact is first and foremost concerned with exhibiting and building the social legitimacy of business and markets." The Global Compact is a network of businesses that have committed to respect the ten principles and work extensively on capacity building among the enterprises.
- The Global Reporting Initiative is a multi-stakeholder initiative that was launched in 1997 by CERES and UNEP. It acts as a network of thousands of experts, in dozens of countries worldwide, who participate in GRI's working groups and governance bodies. These entities use the GRI Guidelines to report, access information in GRI-based reports, or contribute to developing the Reporting Framework in other ways – both formally and informally. The GRI develops a sustainability reporting framework that standardizes enterprises' reports on environmental, social and economic aspects.[22]

18 The term Social Responsibility (SR) was introduced by the International Organization for Standardization (ISO) in their multi-stakeholder approach. ISO 26 000 is not limiting its scope to enterprises but plans to cover a wide range of organization types. It will provide guidelines for Social Responsibility. The guidance standard will be published in 2010.

19 Activities include products, services and processes

20 Relationships refer to an organization's activities within its sphere of influence

21 In the United States of America alone, Françoise Quairel and Michel Capron identified three main approaches: a liberal approach, a moral approach and a stakeholders approach. (Capron et Quairel, 2007)

22 See for more information: **www.globalreporting.org**.

- The OECD guidelines for multinational enterprises is one part of the OECD Declaration on International Investment and Multinational Enterprises, which is a broad political commitment adopted by the OECD Governments in 1976 to facilitate direct investment among OECD Members. The latest revision of the guidelines was conducted in 2000. The guidelines are recommendations addressed by governments to multinational enterprises operating in or from adhering countries (the thirty OECD member countries plus eleven non-member countries). They provide voluntary principles and standards for responsible business conduct, in a variety of areas. They are the only multilaterally endorsed and comprehensive code that governments are committed to promoting.

Those initiatives demonstrate the great importance of CSR in today's political and socio-economic context. Mainstream business magazines frequently allocate whole sections of their publications to the topic. Talking about the social impacts of goods' and services' life cycles, CSR, as a concept and a movement, emerges as a central focus point. It provides useful guidance, resources and frameworks that must be considered. On the other hand, a social and socio-economic Life Cycle Assessment provides interesting and relevant information that brings a new life cycle perspective to CSR. S-LCA may inform and influence CSR in the future, especially in the way the concept is being operationalized.

2.5. Life Cycle Thinking

In parallel with the first steps in the developments of Life Cycle Assessment (see 3.1.), dating back to the early nineties, governments and international organizations, together with the private sector, were called in Agenda 21 – Chapter 4 to "develop criteria and methodologies for the assessment of environmental impacts and resource requirements throughout the full life cycle of products and processes." The ultimate purpose at that time was "assisting individuals and households to make environmentally sound purchasing decisions."

"Life cycle thinking," as an idea, was born. Later on, UNEP explained that "it is about going beyond the traditional focus on production sites and manufacturing processes so that the environmental, social, and economic impact of a product over its entire life cycle, including the consumption and end of use phase, is taken into account."[23]

At the end of the nineties, life cycle thinking, at least from an environmental perspective, became progressively more important for the international community. The Global Ministerial Environment Forum, meeting in Malmö, provided input to the UN's Millennium General Assembly in September 2000 and to the World Summit on Sustainable Development in June 2002, by stating in its declaration: "[Our efforts] must be linked to the development of cleaner and more resource efficient technologies for a life-cycle economy."

Life cycle thinking, essential to sustainable consumption and production, made its way to the highest levels of decision-making. Well-known is the promotion through the UNEP/ SETAC Life Cycle Initiative. The aim of the Life Cycle Initiative consists of "putting life cycle thinking into practice and improving the supporting tools through better data and indicators." Its mission is "to develop and disseminate practical tools for evaluating the opportunities, risks, and trade-offs associated with products and services over their entire life cycle to achieve sustainable development."

As eloquently expressed by Klaus Töpfer, former UNEP Executive Director, there is a strong need to inform production and consumption decisions based on life cycle thinking and assessment tools: "consumers are increasingly interested in the world behind the product they buy. Life cycle thinking implies that everyone in the whole chain of a product's life cycle, from cradle to grave, has a responsibility and a role to play, taking into account all the relevant external effects. The impacts of all life cycle stages need to be considered comprehensively when taking informed decisions on production and consumption patterns, policies and management strategies" (de Leeuw, 2005). This is relevant for governments, enterprises and citizens.

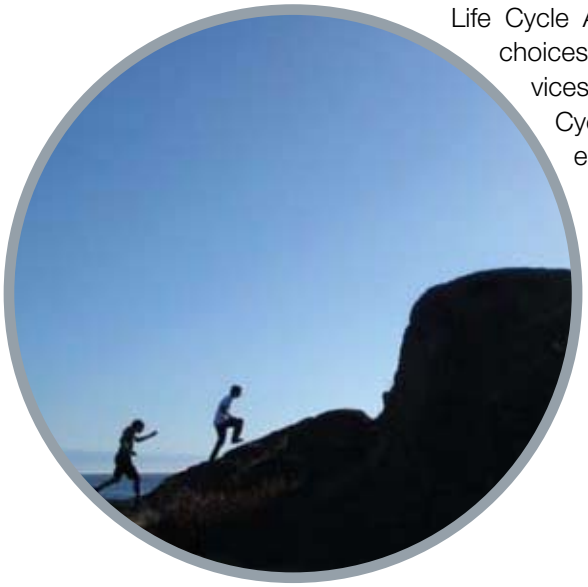
23 See for more information: **http://www.unep.fr/scp/lifecycle**.

A life cycle approach enables product designers, service providers, government agents and individuals to make choices for the longer term. Life cycle approaches avoid shifting problems between life cycle stages or between geographic areas. The shifting from one type of a problem to another can be avoided as well.

Life Cycle Management (LCM) is the organizational dimension of the life cycle approaches. It is an integrated concept for managing the total life cycle of goods and services towards more sustainable production and consumption. LCM uses various procedural and analytical tools for different applications and integrates economic, social and environmental aspects into an institutional context.

LCM is applicable for primary and secondary sectors of economic activity as well as other organizations demanding a system-oriented platform for implementing a preventive and sustainability-driven management approach for goods and services. The organization must "go beyond its facility boundaries" and be willing to expand its scope of collaboration and communication to all stakeholders in the value chain.

The UNEP/SETAC Life Cycle Initiative published *Life Cycle Management, a Business Guide to Sustainability* in 2007. The LCM guide provides a series of key definitions and principles related to Life Cycle Management, a description of the importance and scope of intervention that different areas have in the organizations, and a step-by-step guide, adaptable to enterprises of any size, to support the integration of Life Cycle Management in the management process. The LCM guide laid the groundwork for more detailed publications on the social and socio-economic dimension of life cycle assessment.



Life Cycle Assessment can inform production and consumption choices because it assesses the impacts of goods and services. Environmental Life Cycle Assessment and social Life Cycle Assessment are two complementary techniques, each offering their perspective of the products' life cycle impacts. Life Cycle Costing, in addition, gives information on costs throughout the life cycle of a product. Environmental and social Life Cycle Assessment are methodologies of a wider sustainability toolbox that differ based on their scope (life cycle) and their product focus.

2.6. Related techniques and tools for assessment

Within approaches to sustainable consumption and production, a strong role is played by methods for assessing and reporting the contributions from organizations and their products. Public planning and other strategic decisions are also increasingly assessed from a sustainable development perspective. Social aspects can be assessed through a variety of tools. A social dimension can be included as part of the sustainability assessment or can be handled specifically. The social assessment toolbox is composed of families of tools that serve different goals. The different families may include: analytical tools, procedural and management tools, monitoring tools, reporting tools and communication tools.

The diversity of terminology, the often slight nuances and the variety of disciplines involved in social assessment makes it hard to present a comprehensive picture. Economics, sociology, geography, anthropology, psychology, administration (strategy, management), agronomy, forestry and health sciences have all contributed to the elaboration of a plethora of social assessment tools.

Furthermore, practitioners in different areas have contributed to the elaboration or refinements of many tools (development specialists, CSR experts, etc).

In Table 1, some techniques and tools are listed to provide an indication of what is available. This is not meant to represent a comprehensive picture. Since there is a fine line among the different categories in this table, techniques and tools that are listed as analytical in this table could be considered as being procedural elsewhere. There is also a distinction between techniques, tools and methodologies. The same technique can be applied in many different tools and tools can often include the use of several methodologies, for example, for data collection. In the table, state level assessment tools, such as national statistics, indicator systems and comprehensive state level indexes, such as the GINI index or the Human Development Index, have not been included.

Type of technique or tool / Level of assessment	Project, Intervention or facility	Product	Organization	Community
Analytical tools	Social Impact Assessment (SIA), Health Impact assessment (HIA), Strategic Environmental Assessment (SEA), Human Rights Impact Assessment (HRIA) and Sustainability Appraisal (SA).	Social Life Cycle Assessment, technology assessment	Social accountability, Value chain assessment, Value network assessment, Social footprint, Self-assessment tools.	Participatory Action Research, Agro Ecosystem Analysis. Applied Anthropology, Farming systems research, Rapid Rural Appraisal, semi-directed and open interviews, Questionnaires, surveys, Focus group, directed interviews, social footprint
Procedural and management tools	SA 8000, OHSAS 18001	Life Cycle Management	1) Standards and Certifications: SA 8000, Fair trade –certifications-, AA1000 series, social and sustainable development labels, European quality standard for SRI (CSRR-QS 2.0), OHSAS 18001 2) Guidelines: ISO 26000 (not yet published), SIGMA (Sustainability Integrated Guidelines for Management), OECD guidelines for multinational enterprises, BS 8900, ISAE 3000 3) Performance measure Sustainability balanced Scorecard, EFQM Framework for Corporate Social Responsibility, Investors in people	Local Agenda 21, SD 21000
Monitoring tools	Social Follow up	Social Audits	Social Audits	Evaluation
Communication tools	Certification	Product certification	1) Sustainable development reports 2) Labeling, e.g. Fair trade labels 3) Sustainability / Social indexes	Campaigns
Reporting tools			GRI guidelines Social reporting indicators	Political system

Table 1 – Social assessment tool box

Since different tools focus on different objects they cannot easily replace each other. Nevertheless, some tools may be used to complement each other. What is covered as social (and economic) aspects differs among tools. Indicators developed for particular tools may not necessarily be appropriate for other tools. For example, GRI 3 indicators are developed for enterprises to report – inter alia - on social and economic aspects. They may not be the best-suited indicators for product based assessment such as S-LCA. Social Impact Assessment (SIA) may provide useful information for S-LCA but only cover a glimpse of some phases of a product's life cycle at a particular time. S-LCA is not an addition of SIA results because it involves phases of a project's life cycle (when the product is under production) not generally dealt with in a SIA. However, social assessment tools can draw on one another for data. For examples of complementary use of techniques or tools, we can mention the use of S-LCA within an SIA or use of information (data) from SA8000 or GRI–based information (sustainability reporting) in S-LCA. S-LCA is quite exceptional as it considers social and economic aspects within a product life cycle perspective and may provide a strong basis for reporting and communication (label, information for sustainable development reports).

S-LCA has a lot in common with SIA. Burdge (2004) defines SIA as the systematic appraisal of "impacts on the day-to-day quality of life of persons and communities whose environment is affected by a proposed policy, plan, programme or project" and explains that a good SIA provides "qualitative and quantitative indicators of social impact that can be understood by decision-makers and citizens alike". SIA was developed in the 1970's and was elaborated as an addition to Environmental Impact Assessment. Guidelines for SIA have been developed for instance by the World Bank[24], the International Association for Impact Assessment[25] and USDA.[26] Similar challenges arise in SIA as in S-LCA because it seeks to adapt an assessment methodology designed for environmental aspects and apply it to a socio-economic dimension. Giving a voice to the people, and defining a method for doing so successfully, still represents a major challenge. As in SIA, if S-LCA indicators are developed only in a top down manner they may not represent the views and priorities of the impacted people or their communities. Therefore, it is important to involve and engage stakeholders as much as possible in the study process. The social (and socio-economic) impacts to be covered in an assessment and the way this should be done should be case and context specific. Therefore, there is in general no consensus on which indicators to use and how to assess social impacts of planned interventions with SIA. SIA are often mandatory in the case of large development projects. Even though there are many similarities between S-LCA and SIA, significant differences continue to exist regarding the object and scope of study.

The Social Accountability 8000 (SA8000) Standard is a worldwide accepted certification standard, focusing on enterprises and organizations addressing workers rights. The standard presents a set of criteria and a specific monitoring system that an enterprise needs to comply with in order to be certified. In some cases, the criteria and the monitoring system could be used in a S-LCA.

Another method focusing on sustainability reporting of enterprises and organizations is the Global Reporting Initiative (GRI), which provides a reporting framework for economic, environmental and social aspects including guidelines for performance indicators. As many enterprises use this reporting system, it can provide information for the social and socio-economic assessment of an enterprise.

Account Ability's standards, the AA1000 Series, are principles-based standards that provide a management system for improving the sustainability performance of organizations. They are applicable to any sector, including the public sector and civil society, as well as organizations of any size and in any region.

There also exists a multitude of different sustainability indicator sets that include a social and socio-economic dimension, which have different objectives and foci, e.g. regions, nations, sectors. The basis for the selection of indicators may vary and the data may be of different quality.

S-LCA is intended to assess product and production related social and – to some extent – economic impacts using a life cycle perspective. Most of the mentioned tools can be seen as complementary to this approach. These guidelines aim at providing a general guidance on the use of S-LCA, facilitating a more uniform performance of this technique.

24 See for more information: **www.worldbank.org/socialanalysissourcebook/**
25 See for more information: **www.iaia.org/Non_Members/Pubs_Ref_Material/pubs_ref_material_index.htm**
26 See for more information: **http://www.usda.gov/rus/water/ees/pdf/siaguidelines.pdf**

3. Environmental, Social and Socio-Economic Life Cycle Assessment

3.1. What is Environmental Life Cycle Assessment

Environmental Life Cycle Assessment (E-LCA), normally referred to as Life Cycle Assessment (LCA), is a technique that aims at addressing the environmental[27] aspects of a product and their potential environmental impacts throughout that product's life cycle. The term "product" refers to both goods and services. A product's life cycle includes all stages of a product system, from raw material acquisition or natural resource production to the disposal of the product at the end of its life, including extracting and processing of raw materials; manufacturing; distribution; use; re-use; maintenance; recycling; and final disposal (i.e., cradle-to-grave).

The technique now called E-LCA was originally developed in the late 1960's and throughout the 1970's to address the desire of enterprises and policy makers to understand the relative environmental impacts of alternative packaging options. The scope of environmental impacts grew with time as more studies were performed for more audiences. Initially, the impacts of interest were energy consumption and the production of solid wastes; thus, the inventory data focused on these impacts as well. Emissions of regulated air pollutants were soon added, as were releases of water pollutants.

During the 1970's, 1980's and early 1990's this LCA technique was applied to an increasing variety of product types, and methods for life cycle environmental impact assessment began to be developed. At the end of the 1980's and the early 1990's, a series of workshops were convened by the Society of Environmental Toxicology and Chemistry (SETAC) in order to generate documents, including the initial LCA Code of Practice, published by SETAC in 1993, which promoted consistency and awareness of best practices in E-LCA.

As a means of consolidating LCA procedures and methods, standards were developed as part of ISO's standards on environmental management. Four ISO standards (ISO 14040-14043) were published in the years 1997-2000, all of which were replaced in 2006 with two standards, ISO 14040 (2006) and ISO 14044 (2006). These standards describe the required and recommended elements of E-LCAs.

27 The term environment is often used narrowly to mean the biophysical environment, while ISO 14001 and some LCA practitioners define the environment to include also the social and economic environments of an activity, in which case E-LCA becomes identical to sustainablity LCA. In this text, we use the term E-LCA to cover the more narrow interpretation of biophysical LCAs.

The ISO standards identify four phases for conducting a LCA:

- Goal and Scope--where the reasons for carrying out the study and its intended use are described and where details are given on the approach taken to conduct the study. Notably, it is in this phase of the study that the functional unit (see 4.2.4) is defined, and that modeling approaches are specified.
- Life Cycle Inventory (LCI)--where the product system (or systems) and its constituent unit processes are described, and exchanges between the product system and the environment are compiled and evaluated. These exchanges, called elementary flows, include inputs from nature (e.g. extracted raw materials, land used) and outputs to nature (e.g. emissions to air, water and soil). The amounts of elementary flows exchanged by the product system and the environment are in reference to one functional unit, as defined in the Goal and Scope phase.
- Life Cycle Impact Assessment (LCIA)--where the magnitude and significance of environmental impacts associated with the elementary flows compiled during the previous phase are evaluated. This is done by associating the life cycle inventory results with environmental impact categories and category indicators. LCI results, other than elementary flows (e.g. land use), are identified and their relationship to corresponding category indicators is determined. LCIA has a number of mandatory elements: selection of impact categories, category indicators, and characterization models as well as assignment of the LCI results to the various impact categories (classification) and calculation of category indicator results (characterization). This can then be followed by optional elements such as normalization, grouping and weighting.
- Life Cycle Interpretation, where the findings of the previous two phases are combined with the defined goal and scope in order to reach conclusions or recommendations.

It is important to note that E-LCA provides an assessment of potential impacts on the basis of a chosen functional unit.

3.2 What are Life Cycle Costing and Environmental Life Cycle Costing

Life cycle costing, or LCC, is a compilation and assessment of all costs related to a product, over its entire life cycle, from production to use, maintenance and disposal. It was first developed and used by the U.S. military in the 1960's in order to assess the costs of long living goods such as tanks and tractors (Sherif, Kolarik 1981). The motivation is that, for many products, the purchase price reflects only a minority of the costs that will be caused by the product. Since its early beginnings, LCC is applied in many different industrial sectors and use cases, especially for investment goods (transport – railways, air, sea; building sector; general machinery, chemical industry). A number of industry guidelines and references have been developed but an ISO standard does not exist yet. Products can range from complete office buildings, trains or train carriages to one square meter of carpet (Ciroth, 2008).

Crucial in any LCC are the definition of cost categories, cost "measurement procedures," and modeling decisions such as setting of the system boundaries and of a possible discount rate.

LCC can address the economic impact of a product whose environmental performance is scrutinized in a E-LCA. Since both LCC and E-LCA build on a network of interlinked material flows over the whole life cycle of the product, such a combination is inviting. However, it bears particular modeling pitfalls in order to obtain an "as best as possible" and consistent assessment, without double counting.

A recent SETAC Working Group has developed a methodology for environmental Life Cycle Costing to this end (Hunkeler et al. 2008). A SETAC guideline is under preparation at the moment. Environmental Life Cycle Costing is meant to be applied in parallel to an E-LCA, and is defined as:

> An assessment of all costs associated with the life cycle of a product that are directly covered by any one or more of the actors in the product life cycle (e.g., supplier, manufacturer, user or consumer, or End of Life actor) with complementary inclusion of externalities that are anticipated to be internalised in the decision-relevant future (Hunkeler et al. 2008, p. 173).

System boundaries of the environmental LCC need to be equivalent to E-LCA. They will often not be identical, since research and development, planning and managerial overhead will have decision-relevant costs (and will therefore be considered) even without a significant share of environmental impacts.

Because of the novelty of eLCC and S-LCA, no formal relations between the techniques that can be drawn at the present time.

3.3 What is Working environmental LCA (WE-LCA)?

WE-LCA methods aim to compile and evaluate potential working environmental impacts on humans of a product system throughout its life cycle (Poulsen and Jensen, 2004). Working environmental issues were traditionally not assessed in detail through E-LCA because the focus of the technique was to assess in the first place the potential impacts on the external environment.

In the last fifteen years several groups worked to integrate working environmental issues in LCA: several working environmental LCA methods (WE-LCA) were developed. A WE-LCA allows to examine whether environmental product improvements are implemented at the expense of a deteriorated working environment. WE-LCA assess notably the impacts of emissions in the working environment.

A good example is the publication of the Society of Environmental Toxicology and Chemistry (SETAC, 2004) resulting from a SETAC Europe Working Group on integration of Working Environment in Life-Cycle Assessment (LCA) which describes the state of the art for WE-LCA. The report stressed the interest of including social working environment issues but was limited to the working environmental impacts. Social and socio-economic aspects of working environment are a meaningful part of the methodology developed in these Guidelines for a S-LCA.

Some WE-LCA methods include the assessment of subjects that may be included in an S-LCA, such as work accidents and work atmosphere. When conducting both a S-LCA and a WE-LCA attention should be given to the choice of WE-LCA methodology and/or choice of S-LCA inventory indicators and subcategories in order to avoid double counting. Some groups initially engaged in S-LCA from a working environment angle.

Three types of methods exist to address environmental working environment: screening, sector and process methods. The screening methods are used to pinpoint the important areas in the life cycle of a product, primarily in order to assess whether additional studies are needed (most of the methods developed are chemical screening methods). Sector methods address working environmental issues in a specific line of business (usually sector) and use statistical information from national censuses. Process methods are based on company- or process-specific information, in line with E-LCA for the external environment (exposure of the working force).

Impacts are generally aggregated over the entire life cycle of the product by relating the working environmental impacts to a functional unit. The aggregation in WE-LCA is often carried out by use of working time.

Working environment aspects will likely be increasingly integrated to LCA practice and the guidelines for a S-LCA are clearly setting the stage for notably assessing social working environment aspects in LCA.

3.4 What is a S-LCA and what are the main differences with an E-LCA

In the introduction the S-LCA has been framed as part of the full assessment of goods and services within the context of sustainable development. This section will further detail the S-LCA and the differences with an E-LCA.

3.4.1 What is a S-LCA?

A social and socio-economic Life Cycle Assessment (S-LCA) is a social impact (and potential impact) assessment technique that aims to assess the social and socio-economic aspects of products and their potential positive and negative impacts along their life cycle encompassing extraction and processing of raw materials; manufacturing; distribution; use; re-use; maintenance; recycling; and final disposal. S-LCA complements E-LCA with social and socio-economic aspects. It can either be applied on its own or in combination with E-LCA.

S-LCA assesses social and socio-economic impacts found along the life cycle (supply chain, including the use phase and disposal) with generic and site specific data. It differs from other social impacts assessment techniques by its objects: products and services, and its scope: the entire life cycle. Social and socio-economic aspects assessed in S-LCA are those that may directly affect stakeholders positively or negatively during the life cycle of a product. They may be linked to the behaviors of enterprises, to socio-economic processes, or to impacts on social capital. Depending on the scope of the study, indirect impacts on stakeholders may also be considered.

S-LCA does not have the goal nor pretends to provide information on the question of whether a product should be produced or not. S-LCA documents the product utility but does not have the ability nor the function to inform decision making at that level. It is correct that information on the social conditions of production, use and disposal may provide elements for thoughts on the topic, but will, in itself, seldom be a sufficient basis for decision.

In theory, S-LCA may be conducted on any products, even those that are knowingly harmful to society (e.g. weapons). It is recommended to use S-LCA ethically and it is assumed that peer review will prevent using the methodology inappropriately. Socially responsible investing firms often provide lists of product categories being excluded for ethical reasons. If the product category studied is listed, it is recommended to detail, in the goal and scope phase of the study, the reason why it is ethical and reasonable to conduct a S-LCA of this particular product. Documentation of the product utility and assessment of the use phase of the life cycle will also generally reflect the unethical or harmful nature of the product.

S-LCA is a technique that helps inform incremental improvements but does not in itself provide a breakthrough solution for sustainable consumption and sustainable living. Those topics go well beyond the scope of the tool.

S-LCA provides information on social and socio-economic aspects for decision making, instigating dialogue on the social and socio-economic aspects of production and consumption, in the prospect to improve performance of organizations and ultimately the well-being of stakeholders.

3.4.2 Comparing with an E-LCA

E-LCA and S-LCA have a lot in common. Both methodologies:[28]

- Share a common trunk which consists in the ISO framework (goal and scope definition, life cycle inventory analysis, life cycle impact assessment and interpretation); although there are some specificities for each of these phases in S-LCA;
- Have a huge need for data;
- Work as iterative procedures;
- Encourage and request peer review when communication to the public or comparative assertions are planned;
- Provide useful information for decision-making;
- Do not have the purpose to provide information on whether or not a product should be produced;
- Conduct Hotspots assessments that play the same role;
- Conduct data quality assessment;
- Do not generally express impacts by functional unit, if semi-quantitative or qualitative data are used.

Differences and complementarities are summarized and discussed in this section. Detailed information will be provided in the next chapters.

Complementarity

Environmental LCA, in itself, does not provide all the information to make decisions in a sustainability perspective. A S-LCA provides complementary information, providing a more comprehensive picture of the products' life cycle impacts.

Difference

The most obvious difference between E-LCA and S-LCA is the focus. While the former is concerned with the evaluation of environmental impacts, the latter aims to assess social and socio-economic impacts. While, an E-LCA will mainly focus on collecting information on (mostly) physical quantities related to the product and its production/use and disposal, a S-LCA will collect additional information on organization-related aspects along the chain. Figure 3 illustrates the specificities of the techniques.

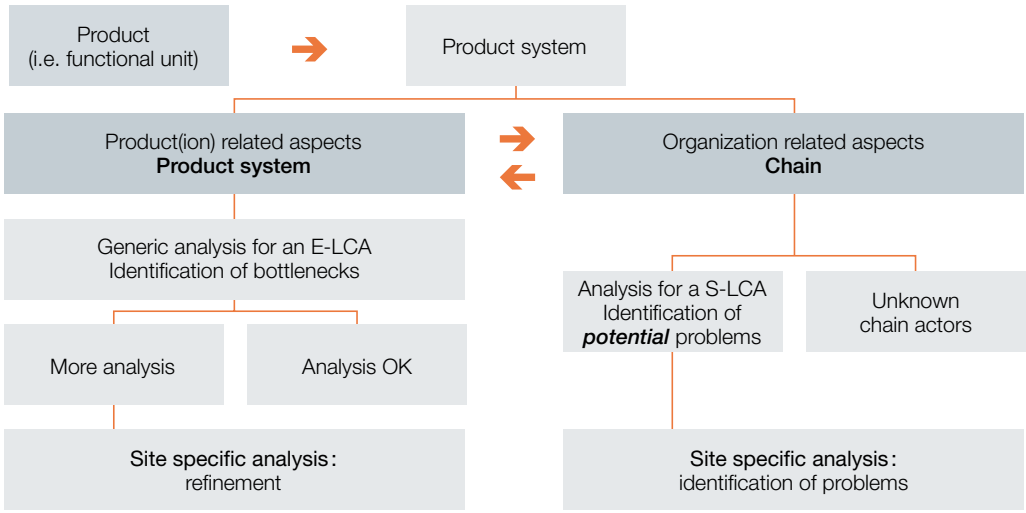


Figure 3 – Twofold analysis of the product system (Adapted from Mazijn et al., 2004)

28 Please refer to the glossary, in Annex 4, to find definitions to a vast number of terms used throughout the document.

Comparison

Although S-LCA follows the ISO 14044 framework, some aspects differ, are more common or are amplified at each phase of the study. Some of these characteristics compare to how E-LCAs are mainly conducted in practice today. Below is a discussion of several attributes which may be present in both E-LCA and S-LCA, but for which the extent or nature of the requirement is different between E-LCA and S-LCA or may be particular to S-LCA.

Phase of the study	Characteristics
Goal and scope	The product utility is required to be described in functional terms, both in E-LCA and S-LCA. S-LCA goes further by also requiring that practitioners consider the social impacts of the product use phase and function.
	Whereas E-LCA encourages involvement of stakeholders (beyond the commissioners) in the peer review of the study, S-LCA encourages that such "external" stakeholders be involved in providing input on impacts, within the assessment itself.
	In S-LCA, justification needs to be presented when a subcategory is not included in the study. In E-LCA this is not a requirement.
	The subcategories are classified both by stakeholder categories and by impact categories in S-LCA. In E-LCA they are classified only by impacts categories.
	Whereas both E-LCA and S-LCA impact assessment methods may be sensitive to location, no E-LCA LCIA methods are site-specific, and E-LCA methods often define and use categories of location types that depend on physical factors such as geography type or population density. S-LCA may require site-specific LCIA in some cases, and may also need information about "political" attributes, such as the country and its laws.
Life Cycle Inventory	The activity variables[29] data is collected and used more often in S-LCA than in E-LCA (e.g. number of working hours for estimating the share of each unit process in the product system). In E-LCA , activity variables are used when data about impacts is not available.
	The subjective data is sometimes in S-LCA the most appropriate information to use. Bypassing subjective data in favor of more "objective" data would introduce greater uncertainty in the results, not less.
	The balance between quantitative, qualitative and semi-quantitative data will generally be different.
	The data sources will differ (coming from stakeholders).
	The data collection steps and methods vary (e.g. the irrelevance of mass balances).
Life Cycle Impact	The characterization models are different.
	The use of performance reference points is specific to S-LCA, e.g. thresholds.
	S-LCA encounters both positive and negative impacts of the product life cycle, beneficial impacts in E-LCA seldom occur.
Interpretation	The significant issues will differ.
	The addition of information on the level of engagement of stakeholders in S-LCA.

Table 2 – Differences between S-LCA and E-LCA

29 Activity variable is a term defined in the glossary.

Discussion of key aspects

Functional unit

In S-LCA, the functional unit is as fundamental as in E-LCA: it is the starting point to determine a product system[30].

E-LCA almost always expresses results per functional unit. This is supported by the fact that the inventory data in E-LCA is almost always expressed exclusively in terms of quantity (of something, usually physical) per unit of process output. However, in both E-LCA and S-LCA the impacts will generally not be expressed by functional unit, if semi-quantitative or qualitative data is used. In contrast, S-LCA often works with information about the attributes or characteristics of processes and/or their owning companies, which cannot be expressed per unit of process output. Such information is therefore not summarized per functional unit, either, when aggregating information across the life cycle in a S-LCA.

Results may be expressed quantitatively using Life Cycle Attribute Assessment[31] if desired. In any case, results need to be expressed in a way that renders the proportional weight of the unit processes in the life cycle of the product.

Data on geographic location of unit process

To have information on the geographic location of unit processes is highly desirable if not necessary in S-LCA. Hotspots can be evaluated generically at the level of the country, but for case-specific S-LCA, more precise geographic information is needed. In E-LCA geographic location can be less important in cases where the same technologies are applied worldwide. However, the impact of a specific emission often varies depending on the local ecosystem affected, so also in E-LCA the awareness of the need to perform site-dependent impact assessment has increased in the recent years.

Stakeholders

A clear difference lies in the fact that inventory data and impact assessment are specified in relation to different stakeholders defined. In S-LCA, stakeholder involvement/participation is also emphasized.

Uncertainty and subjectivity

Both S-LCA and E-LCA seek to minimize the uncertainty in their results, in order to provide clearer support to decision making. While they share this orientation towards uncertainty, they have very different orientations towards the use of subjective information, and its role in reducing uncertainty in the final results.

Inventory data in E-LCA is limited to physical quantities, ideally measured, or estimated based on models, prior measurements, and published data; it does not include subjective information. Impact assessment methods in E-LCA attempt to delay value-based aggregation and to keep it separate from what is considered science-based characterization within an impact category, and possible science-based aggregation of impacts within (broader, more encompassing) damage categories.

Sometimes in S-LCA, subjective data is the most appropriate information to use. Sometimes the data that is sought (because of its empirically demonstrated relevance to social outcomes of interest) is inherently subjective, such as worker reports of their perceived degree of control over their schedules and working environment. In these cases, bypassing data on worker impressions in favor of more “objective” data (such as variability in observed worker arrival times, or other attempted proxies for perceived degree of control) would introduce greater uncertainty in the results, not less.

Impact assessment

S-LCA encounters both positive and negative impacts of the product life cycle and includes these 1) because beneficial impacts are often of importance and 2) to encourage performance beyond compliance (with laws, international agreements, certification standards, etc.). In comparison, beneficial impacts in E-LCA seldom occur, although examples exist (such as CO_2 uptake in the growth of plants). In general, not having impacts is what is desired from an environmental point of view.

30 More information about S-LCA functional unit is available in section 4.2.4.

31 Life Cycle Attribute Assessment is a method that enables to express the percentage of a supply chain that possesses (or lacks) an attribute of interest.

3.4.3 Differences in the scope of the system between S-LCA, E-LCA, CSR, environmental and social impact assessment tools

The following Figure 4 illustrates the scope of data collection and draws attention to a very important distinction between E-LCA and S-LCA. As presented in this figure, environmental LCA does not work with data at the enterprise management level per se, although company management can have a large influence on specific emission factors. Rather, it works with data at the specific site or facility, and on processes within these sites. It reports this information for a system, i.e. the product life cycle. In contrast to E-LCA, S-LCA *can and does* make use of data that is reported/gathered at the enterprise level, such as labor practices.

Another significant point in this figure is that the scope of the system over which results are gathered and reported in a S-LCA, possibly summed-up, is the product's life cycle. This is a similarity between a S-LCA and an E-LCA but a difference when comparing S-LCA with other CSR tools.

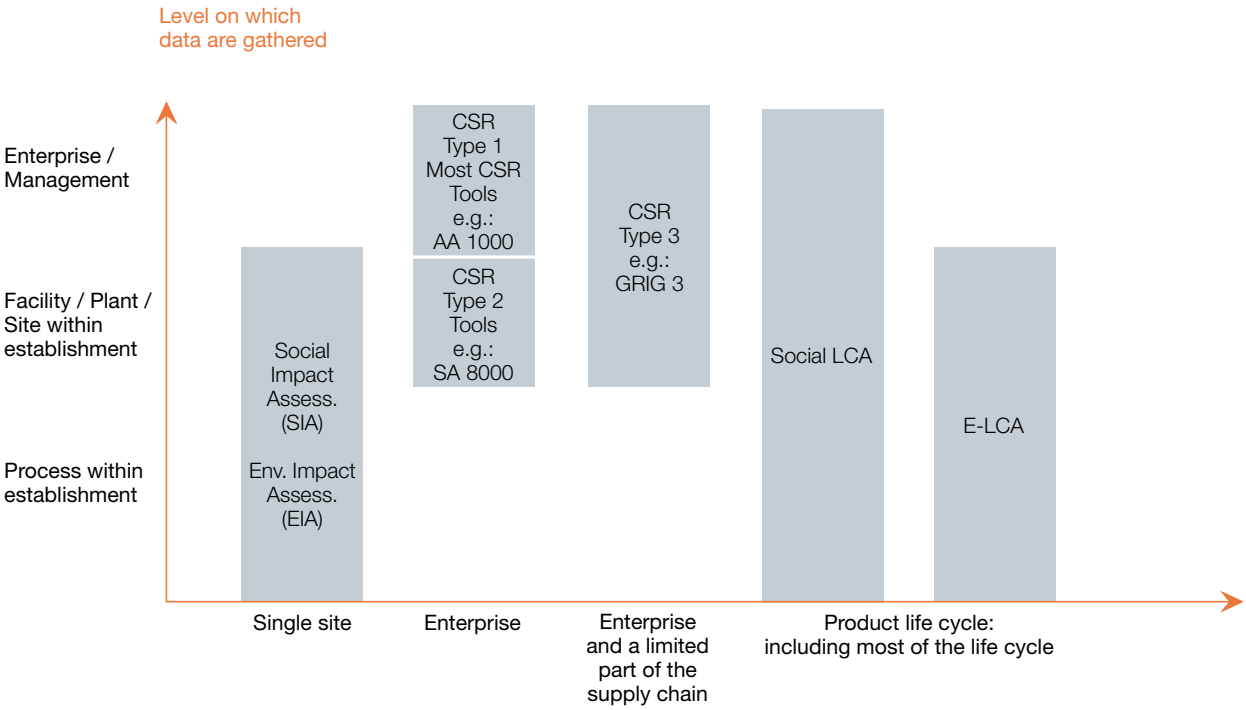


Figure 4 – Scope of CSR and impact assessment techniques of Enterprises and their Product

We can categorize CSR and social impact assessment tools in three types according to the level at which data is being gathered. Type 1 are the tools where data collection is conducted at the enterprise level, type 2 are the tools where the data is being collected at the enterprise and facility level and type 3 are the tools where data collection additionally includes, as a minimum, part of the supply chain.

Most CSR tools and initiatives focus on the enterprise as a whole, therefore these tools are classified as Type 1, and AA1000 standards can be classified in this category. Type 2 CSR tools focus in addition on the facility and SA 8000 can be considered as Type 2. Type 3 tools include at least part of the supply chain. GRI started as a Type 1 tool, expanded to reach Type 2, and is now expanding to Type 3, although the supply chain coverage is still very limited. Most Type 3 CSR tools stop their assessment at the first tiers of suppliers. In comparison, S-LCA goes far beyond the first tier, as well as downstream to include the product use and disposal.

However, if S-LCA looks at organizations' management practices, its focus is always the product and it will always try to get to the information that is related to the facility where the unit process is located. That said, for many subcategories, e.g. public commitments to sustainability issues, the information is available solely at the enterprise/organization level.

In conclusion, S-LCA is a technique within which methods are being developed for associating company-level information with processes in a life cycle system and for reporting and possibly summing up this information across product life cycles.

4. Technical Framework for Social Life-Cycle Assessment

Whenever possible, the S-LCA draws largely on the E-LCA methodology. In this chapter, the four major phases (goal and scope of the study, inventory analysis, impact assessment, and interpretation) of the methodology will be presented and detailed in a systematic manner. Before going into details some important general considerations need to be stated.

4.1. General Considerations

Goal of the section:
This section presents the general orientations and the main concepts related to the assessment of social and socio-economic impacts of a product's life cycle.

What is to be achieved in these general considerations:
Key information will be provided about the perspectives adopted on social impacts, the underlying concepts and their articulation in a reference framework for social and socio-economic Life Cycle Assessment.

Guidance:
- Definition of concepts
- Illustration of the product's life cycle
- Presentation of the Stakeholder categories
- Presentation of the Subcategories

Two types of considerations will be discussed here: orientations suggested towards the assessment of social and – to some extent – economic aspects, and technical considerations. The orientations are discussed through three topics: (1) the definition of social impacts; (2) the classification of social and socio-economic indicators; and (3) the development of subcategories for social and socio-economic impacts assessment of products.

What are social impacts?
Social impacts[32] are consequences of positive or negative pressures on social endpoints (i.e. well-being of stakeholders). Social impacts are understood by these Guidelines to be consequences of social relations (interactions) weaved in the context of an activity (production, consumption or disposal) and/or engendered by it and/or by preventive or reinforcing actions taken by stakeholders (ex. enforcing safety measures in a facility). When referring to the causes of social impacts, this generally implies three dimensions:

- behaviors: social impacts are those caused by a specific behaviour (decision). E.g. forbidding employees to form unions, allowing illegal child labor, and seizing employees' identity papers.
- socio-economic processes: social impacts are the downstream effect of socio-economic decisions. The question arises "What is chosen, both at the macro and micro level?". E.g. an investment decision in a sector to build infrastructure in a community.
- capitals: (human, social, cultural): social impacts relate to the original context (attributes possessed by an individual, a group, a society e.g., education level). They can either be positive or negative. For example the human capital might suffer from a high percentage of individuals being HIV positive. In this case a negative social impact may strike harder in this specific context or a positive may be of higher value.

32 Social impacts may also be the consequences of biophysical pressure but this dimension is not covered in the context of these guidelines.

Those three dimensions are not exclusive and have dynamic relationships: socio-economic processes have effects on behavior that may also be rooted in the attributes possessed by an individual or a group. For example, pressure for low prices (socio-economic processes) may draw suppliers to allow illegal child labor (behavior), a practice that may be accepted in a given society because of systemic poverty (capital).

Social impacts are often perceived as being very complex. Indeed, they are the result of relationships and relationships always carry a set of different angles: Social impacts are function (f) of: (politic, economy, ethics, psychology, legal issues, culture, etc.)

In addition, social impacts feed back to the production system and the society and thus change other social and environmental impacts. Because of this complexity and this subjectivity, it is not recommended to define attributes of relationships unilaterally and from there define a set of related indicators isolated from the stakeholder context. As for environmental impacts (cf. the doubts expressed by the non-believers of human-induced climate change), defining social impact categories needs to go through a subjective and inter-subjective process, preferably at the international level.

Assessment framework

Subcategories are the basis of a S-LCA assessment because they are the items on which justification of inclusion or exclusion needs to be provided. The subcategories are socially significant themes or attributes. Subcategories are classified according to stakeholder and impact categories and are assessed by the use of inventory indicators, measured by unit of measurement (or variable). Several inventory indicators and units of measurement/reporting types may be used to assess each of the subcategories. Inventory indicators and units of measurement may vary depending of the context of the study.

Social/socio-economic subcategories may be first classified by stakeholder categories as this might assist with the operationalization. It can also ensure the comprehensiveness of the framework.

The purpose of the classification into impact categories is to support the identification of stakeholders, to classify subcategory indicators within groups that have the same impacts, and to support further impact assessment and interpretation. The impact categories should preferably reflect internationally recognized categorizations/standards (like the UN declaration on economic, social and cultural rights - ECOSOC, standards for multinationals) and/or result from a multi-stakeholder process.[33]

The following figure illustrates the assessment reference framework.

33 See Section 4.4.2.1 on Impact categories for more detail

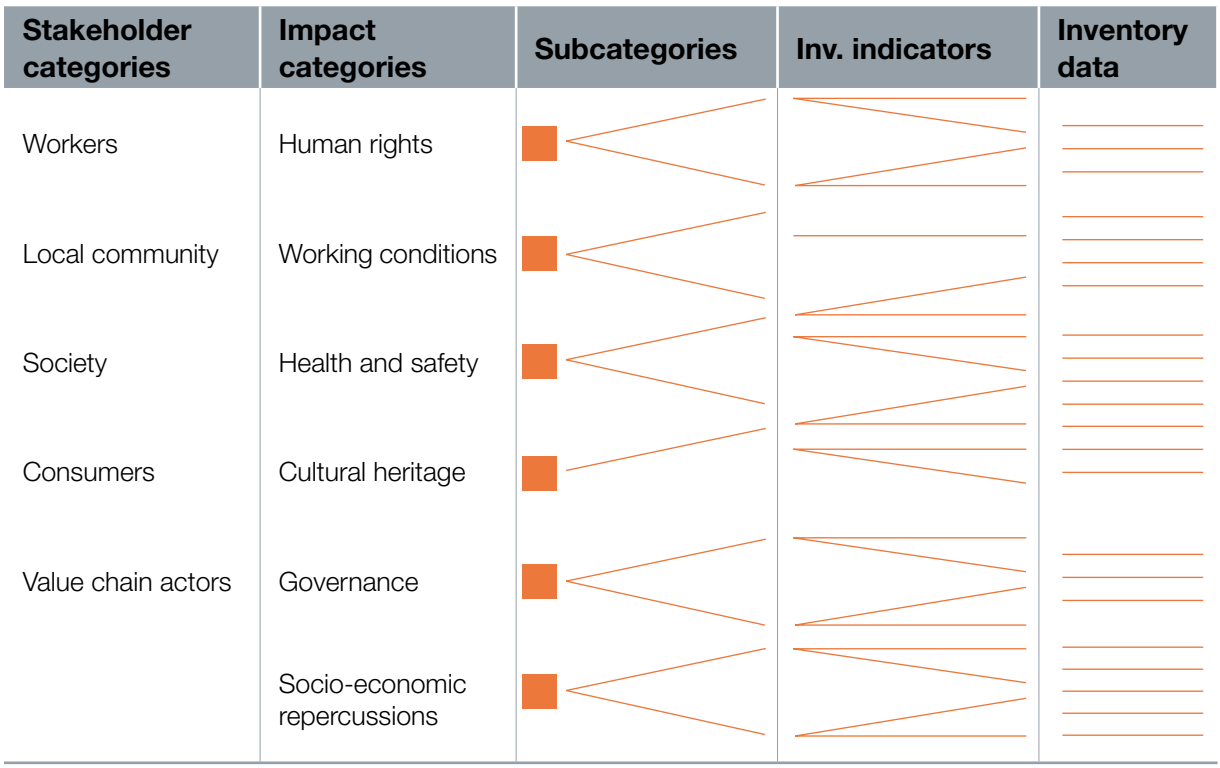


Figure 5 – Assessment system from categories to unit of measurement. Adapted from Benoit et al., 2007

Classification of social and socio-economic subcategories

There are two proposed subcategories classifications schemes proposed, which are complementary and not contradictory: The stakeholder classification and the classification according to impact categories. The stakeholder categories will be discussed in this section whereas the impact categories will be discussed in section 4.4.2.1.

Stakeholder categories

As discussed in Section 3.2., a S-LCA assesses the social and socio-economic impacts of all life-cycle stages from cradle to grave, looking at the complete life-cycle of a product. These are related to resource extraction, processing, manufacturing, assembly, marketing, sale, use, recycling, and disposal, among others, that may be identified during the construction of the product system.

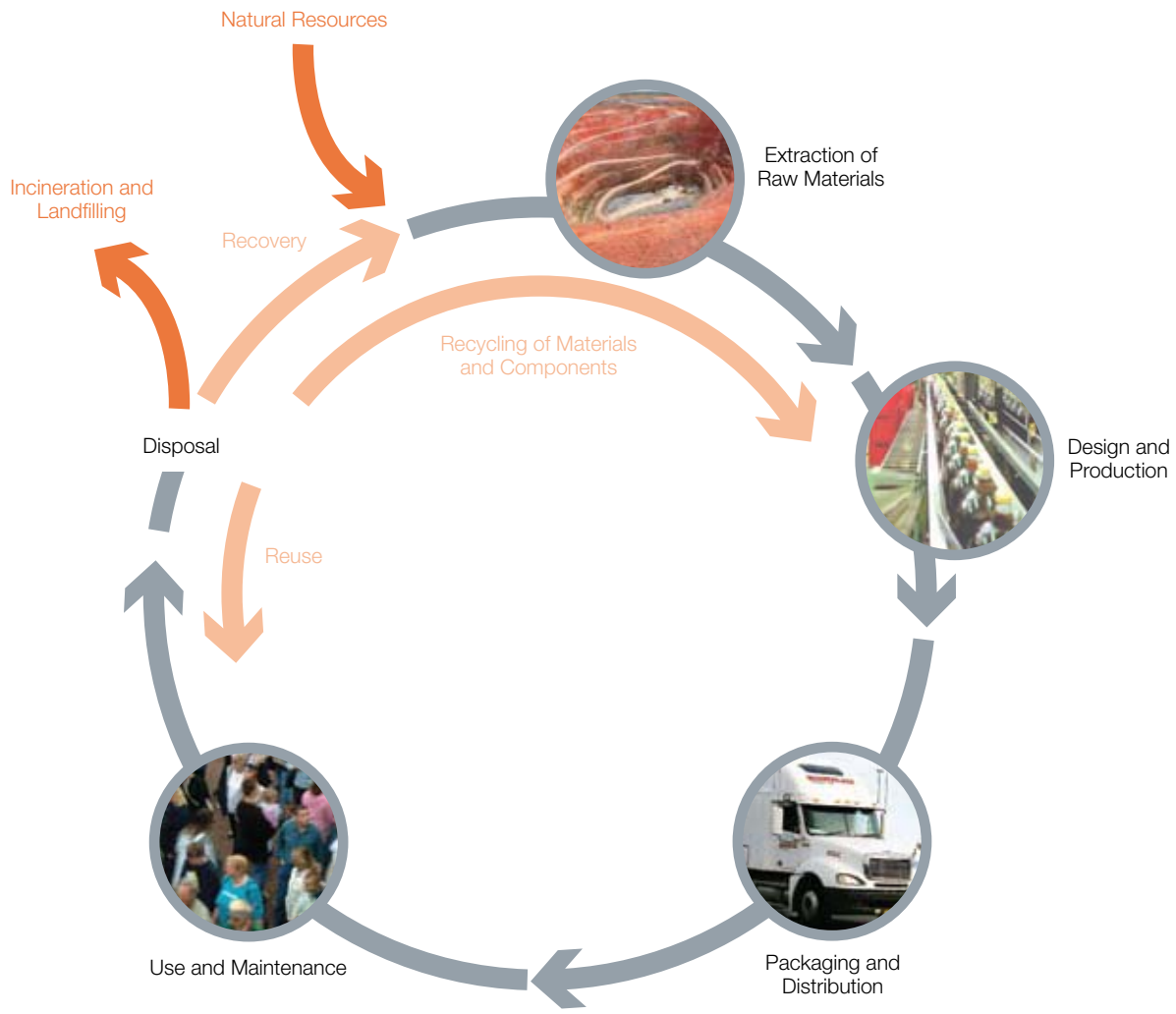


Figure 6 – The Product Life Cycle

Each of these life cycle stages (and their unit processes) can be associated with geographic locations, where one or more of these processes are carried out (mines, factories, roads, rails, harbors, shops, offices, recycling-firms, disposal-sites).

At each of these geographic locations, social and socio-economic impacts may be observed in five main stakeholder categories

- Workers/employees;
- Local community;
- Society (national and global);
- Consumers (covering end-consumers as well as the consumers who are part of each step of the supply chain) and
- Value chain actors

A stakeholder category is a cluster of stakeholders that are expected to have shared interests due to their similar relationship to the investigated product systems. The stakeholder categories provide a comprehensive basis for the articulation of the subcategories. The proposed stakeholder categories are deemed to be the main group categories potentially impacted by the life cycle of a product.

Additional categories of stakeholders (e.g. NGOs, public authorities/state, future generations) or further differentiations or subgroups (e.g. management, shareholders, suppliers, business partners) can be added. By adding more stakeholder categories, more detailed and precise subcategories of a specific stakeholder of concern may be identified.

Box 2

The State as a stakeholder

The State is a multidimensional stakeholder playing several roles. States have a crucial regulatory role, they may be the organization producing the product, they may be impacted by or play an important role in relation with the product utility. They may, as a government organization, also be impacted by the life cycle of a product.

The State, in its regulatory role, is one of the main sources of characterization and interpretation information along with international conventions and treaties (negotiated by states) and recognized best practices.

When being the organization producing the product, or owning the facility of a specific unit process or being responsible for the disposal, the specific government body or bodies need(s) to be identified according to its (their) role.

The relation of the State towards the product utility may be stressed when the information is important according to the Goal and Scope and the nature of the product studied (e.g. the limits to the use of GMO).

The State is not proposed as a separate stakeholder category in this framework because the impact of the product's production on governments is not a dimension that has been put forward in CSR framework and literature. It is not being considered, in the moment, as being one of the key issues. However, it is possible, because of the goal and scope definition of a study, that a need to address specifically this stakeholder will arise.

It is true that the strength and action of a government, its policy, its regulations and its ability to enforce those will affect the capitals and the actions of stakeholders and ultimately the impacts of different unit processes. Therefore, when interpreting the results and planning an improvement strategy, this information may be taken into account.

It must be clear that even if the States are not identified separately as a potentially impacted stakeholder category, its distinctive importance and role is not disregarded. It is because of its special and crucial role that it appears in a transversal manner in the S-LCA framework.

When conducting the goal and scope phase of a study, one may refer to a stakeholder classification[34] and, according to this, classify the subcategories (comparable to GRI and other international schemes). In the phase of impact assessment one can additionally arrange the social and socio-economic subcategories according to impact categories. The resulting list of subcategories may be classified in a table, where the first column represents the stakeholder groups and the second column identifies the impact areas. One impact category can be related to several stakeholder categories, one stakeholder category can be affected by different impact categories.[35]

The purpose of the classification of subcategories according to stakeholder groups is to make sure that the S-LCA matches the goal and scope and is assessing the bulk of the situation. For practical reasons and following the common practice, the stakeholder categories are defined below. It is clear that stakeholders can vary not only from one study to the other but also within each step of the supply chain. Subcategories represent the basis for a S-LCA. However, efforts will have to be made, while conducting a S-LCA, to find and (re-)define the appropriate indicators (to assess the subcategories) adapted to the particular context and understanding.

34 Stakeholders are "… those groups and individuals that can affect, or are affected by, the accomplishment of organizational purpose" (Freeman R., 1984).

35 Refer to Figure 6

Development of subcategories

First of all, social and socio-economic subcategories have been defined according to international agreements (conventions, treaties etc). In a next step, best practices at the international level have been taken into account: international instruments, CSR initiatives, model legal framework, social impacts assessment literature.

It is within this context that a comprehensive set of subcategories is presented below. To go beyond personal and cultural subjectivity or political orientation, it is helpful to support the definition of categories, subcategories and inventory indicators with proper references to international instruments. The international conventions on Human Rights and Workers Rights are a good basis for a S-LCA indicators framework. International conventions are valuable instruments that have been negotiated by countries.[36] They are the best example of a universal set of social criteria[37].

However, social conventions often represent a minimum to attain and non-compliance represents, in many countries, a criminal offence. Additional international instruments, initiatives, best practices, model legal framework, etc., guide the development of additional categories and indicators that go beyond minimal compliance and assess additional and complementary social impacts.

Different contexts will represent different challenges and will need varying levels of assessment. For example, the legislation in developed countries may already cover many of Human Rights and Worker Rights indicators and the application of the law may be excellent. However, this might not be the case in a developing country. International standards tend to define floors rather than ceilings. However, it is important to emphasize that this should not be taken for granted. For example, in many cases, enterprises in developed countries are not allowing freedom of association. Therefore, as part of the assessment, screening for minimum compliance when thresholds exist, and possibly also to assess performance beyond compliance thresholds, is suggested. These are elements that should be accounted for and described in the interpretation phase of the study. Comparative studies must be conducted with the same level of assessment.

36 See the presentation and discussion of Human Well-Being, Section 2.2.

37 The International Labour Organisation e.g. is the tripartite UN agency that brings together governments, employers and workers of its member states in common action – inter alea – to maintain and develop a system of international labour standards aimed at promoting opportunities for women and men to obtain decent and productive work, in conditions of freedom, equity, security and dignity.

Stakeholder categories	Subcategories
Stakeholder "worker"	Freedom of Association and Collective Bargaining Child Labour Fair Salary Working Hours Forced Labour Equal opportunities/Discrimination Health and Safety Social Benefits/Social Security
Stakeholder "consumer"	Health & Safety Feedback Mechanism Consumer Privacy Transparency End of life responsibility
Stakeholder "local community"	Access to material resources Access to immaterial resources Delocalization and Migration Cultural Heritage Safe & healthy living conditions Respect of indigenous rights Community engagement Local employment Secure living conditions
Stakeholder "society"	Public commitments to sustainability issues Contribution to economic development Prevention & mitigation of armed conflicts Technology development Corruption
Value chain actors* not including consumers	Fair competition Promoting social responsibility Supplier relationships Respect of intellectual property rights

Table 3 – Stakeholder categories and subcategories

4.2. Definition of Goal and Scope

Goal of the section:
This section details what needs to be done when conducting the Goal and Scope phase of a S-LCA.

What is to be achieved in the Goal and Scope:
The first thing needed when initiating a S-LCA is a clear statement of purpose, *the goal.* This statement describes the intended use and the goal pursued. The study will then be defined to meet that purpose, within any constraints. Depending on the goal, a critical review may be planned.

The second step is to define the scope. As part of defining the scope, the function and the functional unit of the product is defined. Based on that information the product system will later be modeled using process or input-output data. In the scope phase, the depth of the study is defined and decisions about which unit processes requires generic or specific data collection are made. In order to define the depth of the study, activity variables (such as worker hours or value added) may be used.

Guidance:
The Goal and scope phase consists in a set of actions summarized below:

- To specify the object and objectives of the study (including the goals, the function of the product, the product utility, the functional unit, etc.)
- To determine the activity variable to be used and the unit processes to be included.
- To plan data collection and specify which data will be collected and on which impact categories and subcategories.
- To identify the stakeholders involved with each of the processes and the type of critical review required.

4.2.1. General

The ultimate objective for conducting a S-LCA is to promote improvement of social conditions and of the overall socio-economic performance of a product throughout its life cycle for all of its stakeholders. Achievement of minimum benchmarks or thresholds of performance is recognized by the methods, but so are positive impacts that go beyond compliance.

As one underlying goal of using the results of S-LCA is to stimulate improvement of social (and socio-economic) conditions, dialogues among stakeholders, decision makers and commissioners of the S-LCA study are highly important. Participation of stakeholders in the goal and scope definition should be encouraged (taking in account means available for the research).

4.2.2. Goal of the study

The first step of the S-LCA aims to describe the study. Why is a S-LCA being conducted? What is the intended use? Who will use the results? What do we want to assess? The definition of the goal has to be clearly specified to ensure the study will fulfill the intended application.

The intended application of a S-LCA could be, for instance, learning about and identifying social "hotspots" and the options for reducing the potential negative impacts and risks through product development and substitution in the supply chain, establishment of purchasing procedures or specifications, marketing, reporting and labeling, strategic planning, or development of public policies.[38]

The description of the intended application and reasons to carry the study should be provided to the data collectors.

Depending on the planned application and the reasons for carrying the study, the intended audience may include the organization carrying out the study, trade unions and workers' representatives, consumers, governments, NGOs, IGOs, shareholders, product designers, etc.

Finally, in order to plan, if necessary, the peer review of the study, it must be specified "whether the results are intended to be used in comparative assertions or intended to be disclosed to the public (ISO 14040, 2006)."

38 The different applications of LCA have been classified by Weidema. (1998).

4.2.3. Scope of the study

The scope is also defined in the first phase of the study. It encompasses issues of depth and breadth of the study. It defines the limits placed on the product's life-cycle (which ideally is the border between the economy and nature) and on the detail of information to be collected and analyzed. It defines where the data will be coming from, how up-to-date the study will be, how information will be handled, and where the results will be applicable.

ISO 14040 (2006) specifies: "The scope should be sufficiently well defined to ensure that the breadth, depth and detail of the study are compatible and sufficient to address the stated goal." Process chains in existing E-LCA models[39] provide a valuable starting point for the system scope for a S-LCA.

Process chains detail the series of operations performed in the making, treatment, use and disposal of a product. Process chains may be built based either on process data or economic input-output data supplemented with environmental data, or both. The economic input-output method considers an entire economy – all activities of all industry sectors-- but the processes are relatively aggregated. On the other hand, the process method offers detailed information on specific processes but important parts of the product systems may be left out because of the difficulty of following the entire supply chain in detail.

The product system, made of the process chains, is usually depicted in a process flow chart. The process flow chart shows the main sequence of production, with a varying level of detail: from resource to product to waste. The system must also include energy and ancillary materials (input) that support the main production, and the production of all the input themselves. If all the loops are left out, the product life cycle flow chart can be made to resemble a tree with many roots and branches.

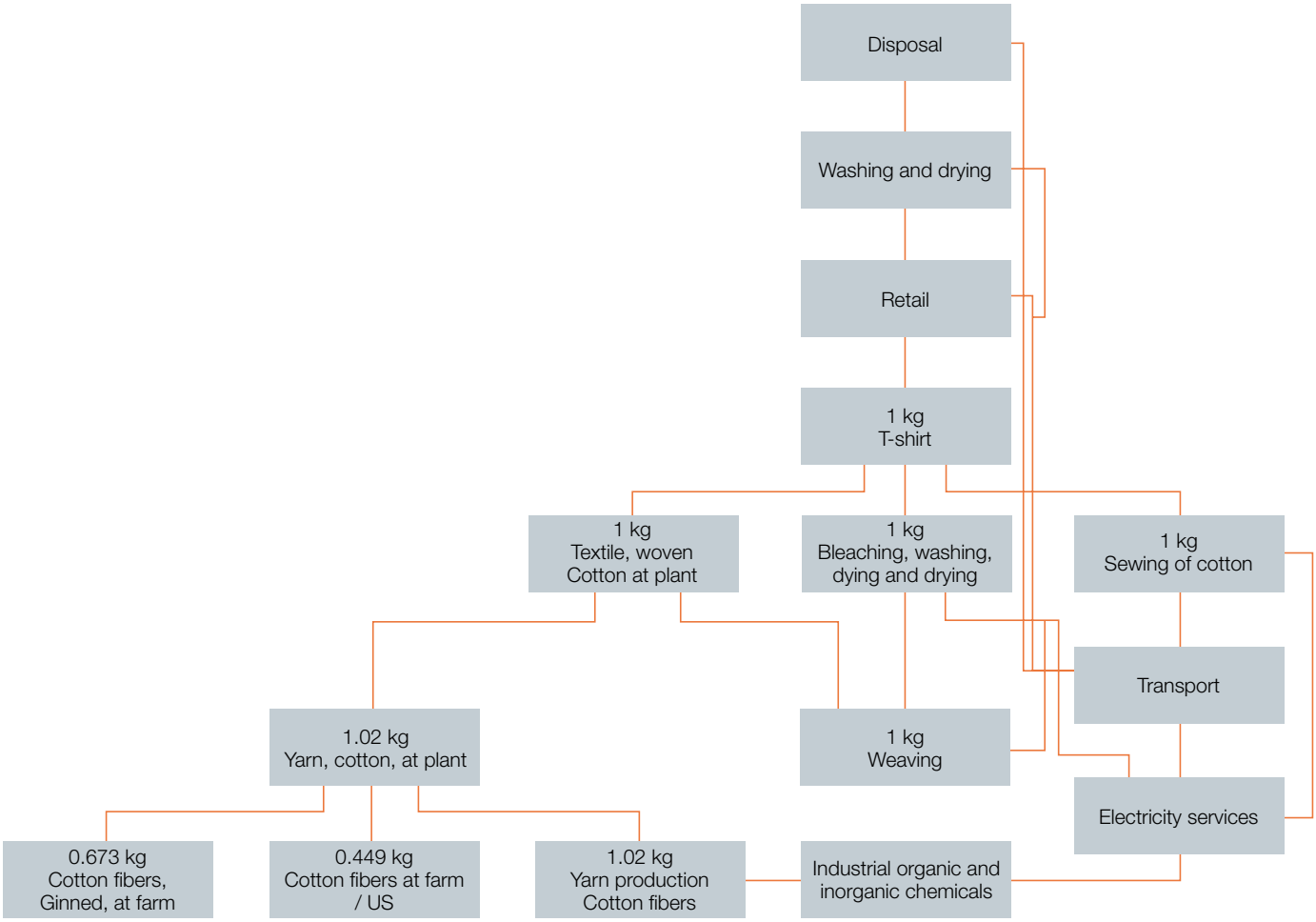


Figure 7 – Representation of a product system

39 In other words both process databases and IO databases, which are quite different. IO databases being more comprehensive in terms of linkages but less precise in data for a certain process or product.

Because the focus of the assessment in S-LCA is the product, it is necessary to build the product system. Economic and/or physical relations seem best suited to define and detail what the product system consists of.

The next step in the S-LCA goal and scope phase is to decide whether to expand the system scope. In expanding the system scope, the following steps are recommended:

1) define the ideal system (example provided in Annex 2);

2) define the actual system to be modeled;

3) decide which processes to gather site specific data for, and which processes to model with generic data.

The scope of a study can greatly affect the results. As such, practitioners should ensure that they adequately describe the function (including the product utility), the functional unit and other scoping decisions (in particular the stakeholders and types of impacts to be considered, the subcategories that will be included, whether generic or site specific data will be collected and for which unit processes should be described).

The following list, which has been amended from ISO 14044 (2006) (with amendments noted in italics), reports a number of items that should be "considered and clearly described" in the scope of a S-LCA study:

- the product system to be studied;
- the functions of the product system or, in the case of comparative studies, the systems;
- the functional unit *(with special emphasis on product utility)*, defined in time and space;
- the system boundary *(ideal system and actual system)*;
- *the activity variable to be used (to inform on the relative importance of each unit process);*
- the data type to be collected (generic, specific);
- *the stakeholder categories to include;*
- *the subcategories to include;*
- *the types of impacts to be considered;*
- *the inventory indicator and data related to those impacts;*
- *the methods for impact assessment;*
- the allocation procedures;
- the interpretation planned;
- the assumptions;
- the value choices and optional elements;
- the limitations;
- the data quality requirements;
- the type of critical review, if any;
- the type and format of the report required for the study.

As a practical matter, ISO 14044 (2006) also states that "the goal and scope of the study may be revised due to unforeseen limitations, constraints or as a result of additional information. Such modifications, together with their justification, should be documented."

4.2.4. Functional unit

It is necessary to specify the function and the functional unit in a S-LCA. As stated in ISO 14044, (2006): "The scope shall clearly specify the functions (performance characteristics) of the system being studied." The function is the utility, the role that the product plays for its consumers.

Specification of the functional unit and the reference flows is essential to build and model the product system. Modeling the product system is essential to identifying locations and specific stakeholders involved. It is also important in estimating the need for and setting targets for site-specific data collection.

When using qualitative indicators and data in S-LCA, it may be difficult to link the results specifically to the functional unit. It is still necessary, though, to define the functional unit, as well as the product utility, in the goal and scope phase of the study, as this provides the necessary basis for the product system modeling.

In order to specify the functional unit, practitioners need to clearly define the function of the product. For example, which function will be filled by the use of the product is a question that needs to be answered. In order to help define a valuable functional unit, five steps are proposed (Weidema *et al.*, 2004):

Step 1: Describe the product by its properties including the product's social utility.
Step 2: Determine the relevant market segment.
Step 3: Determine the relevant product alternatives.
Step 4: Define and quantify the functional unit, in terms of the obligatory product properties required by the relevant market segment.
Step 5: Determine the reference flow for each of the product systems.

These five steps can be performed in an iterative or concurrent way.

In S-LCA, the definition of the function (Step 1-2-3) needs to consider both the technical utility of the product and the product's social utility, which can be described as "a range of social aspects such as time requirement, convenience, prestige etc." (Griesshammer R. et al., 2006; see also Weidema *et al.* 2004).

The overall properties of the product *may be* related to:

- *Functionality,* referring to the main function of the product,
- *Technical quality,* such as stability, durability, ease of maintenance,
- *Additional services* rendered during use and disposal,
- *Aesthetics,* such as appearance and design,
- *Image* (of the product or the producer),
- *Costs* related to purchase, use and disposal,
- *Specific environmental and social properties.*

These properties are in turn determined by the requirements in the market in which the product is to be sold. The criterion to determine whether a product property is to be included in the functional unit or not is whether it is an obligatory product property, i.e. a property that the product *must have* in order to be at all considered as a relevant alternative (Weidema *et al.* 2004). The functions of two products to be compared may differ, but the functional unit must be the same. Of course, a difference in functions makes the assessment weaker and should be kept in mind for the interpretation phase.

The functional unit must be based on the function and not on the item, especially when the goal is to compare two products. One of the primary purposes of a functional unit is to provide a reference to which the input and output data are normalized (in a mathematical sense). Therefore, the functional unit shall be clearly defined and measurable. The functional unit shall also be consistent with the goal and scope of the study.

ISO 14044 (2006) defines reference flow as "the measure of the outputs from processes in a given product system required to fulfill the function expressed by the functional unit." *A reference flow* is a quantified amount of product(s), including product parts, necessary for a specific product system to deliver the performance described by the functional unit. Reference flows translate the abstract functional unit into specific product flows for each of the analyzed product systems.

The reference flows are the starting point for building the necessary models of the product systems. They provide a reference for the "weight" of the different enterprises in the supply chain. For example, from the reference flows of a certain product, one can identify the inputs of the different enterprises in the supply chain required in order to deliver the function (product). From the reference flows, the necessary contributions can be expressed for each organization, using activity variables such as monetary value (expressed in currency) or working hours, for instance.

Box 3

Example of a function, functional unit and reference flows in S-LCA:

Step 1: Describe the product by its properties including the product social utility:

In order to define the function, the product needs to be identified and described. This example will use a shirt. However all shirts are not equal. First the shirt needs to be described:

Is it a T-Shirt? Is it a long sleeve shirt? Is it a woolen shirt?

Let say, in this case, we are talking about a T-Shirt made by the company P, a popular brand of sport items.

What are the properties that we can identify for this T-Shirt?

Functionality: To cover the body, to keep a person comfortable and dry…
Technical specification: Cotton, short sleeves, no buttons, durable and washable…
Additional services: To be used as a cloth after discarding …
Aesthetics: To be embroidered and printed and to have a design that is distinguishable from last year's design…
Image: To be of a popular sport brand…
Costs: To be of a maximum of xx $ cost, affordable to a consumer of median income
Specific environmental and social properties: To be made of certified organic material

Step 2: Determine the relevant market segment.

Casual, athletic, image and environmentally conscious

Step 3: Determine the relevant product alternatives.

Brand X, Y and Z, which together make up 85% of the high-level market for T-shirts

Step 4: Define and quantify the functional unit, in terms of the obligatory product properties required by the relevant market segment.

2 years of service as T-Shirt with the obligatory properties. This corresponds to 70 days of wearing with the same number of washings.

Step 5: Reference flows:

1 T-shirt weighting 250 grams, plus average water, detergent and washing machine required to wash a T-shirt 70 times, disposal of 250 grams cotton textile.

Next step: When the modeling of the system is done, activity variables may be collected (e.g. the worker hours necessary at each unit processes to provide the input to the final product).

4.2.5. System Boundaries

System boundaries refer to the determination of which unit processes should be included in the system being assessed. What is the product system that will be explained and the procedure by which it should be defined within a S-LCA?

4.2.5.1. Conceptual system

There is no such single, **objective** thing as a product life cycle.

A product life cycle is an *idea.* While the boundaries can unambiguously be defined, meaning what-is-in-and-what-is-out for an enterprise, for a plant/establishment, and for a unit process, this is not true for a "product life cycle."

There are two scope dimensions impacted by this conceptualization: the processes or activities that are considered part of the (idealized or total) product life cycle (and thus should be included in the life cycle inventory model), and the "elementary flows" or "pressures" or other attributes of those processes/activities which may be included in the inventory data. This section focuses on the first of these two scope dimensions: the processes or activities that are considered part of the idealized or total product life cycle.

This implies that the statement of the goal and scope is not simply based on available time, money or data: it is much more subtle. Rather, the first message is that even *if we had an unlimited research budget and unlimited time and were omniscient (all-knowing),* we could **still** disagree about what *should be included* in the boundary of "a product life cycle" for life cycle assessment.

Different people will define this total desired abstract system differently. On what basis will they do this? Some of the determinants are people's ideas or conceptions of the overall purpose of the methodology, the fundamental reasons why the modeling is being done and the kind of question the models are intended to help answer. Another determinant, which is often implicit and perhaps unknown to the practitioners themselves, are the elements of their world-view, the scope of the professions in which they are trained and work. Another more pedantic determinant is the realities of people's existing databases and the details of how they have done modeling in the past. The influences of these drivers on the ideal system, on the model that is attempted and on the data that are used in a study are summarized in Figure 5.

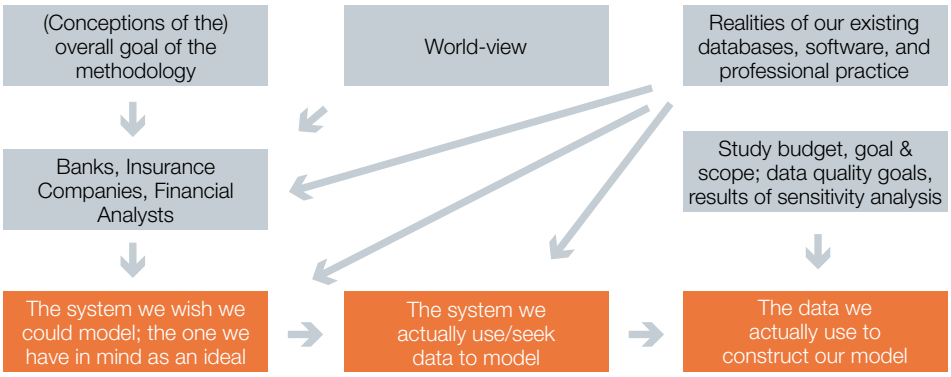


Figure 8 – Influences of drivers on the conceptual system (incl. model and data) in a study area.

The interconnected system of unit processes we will attempt to model – that is, for which we will link some data as a model - depends first on the conceptualization – that is, on the scope of the ideal system. This in turn depends on ideas about the purpose of the whole methodology, and it depends on the method developers' and practitioners' world-views. Let us call this system the "ideal system," meaning "the system of processes for which we wish we had, or could have, data, in an ideal world with no budget or time limitations."

Practitioner world-view sounds abstract but it is not. E-LCA has evidently been motivated from the very start by the goal of helping people understand the environmental implications of product choices.[40] Yet, people's professional (and personal) world-views determine what aspects of the world they measure and model in response to this goal. Engineers and physicists at Franklin Associates, for example, responded to this goal by building models physically describing "how things are made," and they have been building E-LCA models in this way ever since. This has become known as "attributional" modeling, as opposed to "consequential" modeling that describes "how decisions affect the World." As we will see, people trained in different professions tend to view different aspects of the World to be both important and missing from each others World view and the resulting models.

Five illustrations that help to clarify why different practitioners and studies can adopt different conceptions of the ideal system can be found in Annex 3.

4.2.5.2 Modeled system

ISO 14040 (2006) mentions that the product system should be modeled in such a way that only elementary flows cross the system boundaries, i.e. that no product or intermediate product flows (economic flows) enter or exit the product system. This principle also applies to S-LCA: product systems should be modeled in such a way that these product flows do not cross the system boundaries.

It is suggested to apply iterative refinement to system boundary setting. Iterative refinement is recommended by ISO 14040 (2006) calling for sensitivity assessments of system boundaries during modeling (rather than after the study is done).

Using E-LCA system boundary setting and building upon it for S-LCA while explaining choices is suggested. Care should be taken in consequential assessments, since activities where important consequences arise as a result of an action or decision may differ between E-LCA and S-LCA. So far, S-LCAs have mainly been conducted using attributional modeling, but as practices evolve, consequential S-LCA is likely to develop (e.g., to inform technology choices--biofuels are a good example).

As experience is acquired through increasing S-LCA practice, the reasons why S-LCA system boundary may or may not differ from E-LCA system boundary will become clearer. As more experience needs to be gained on the topic of what is left out of the system and why, it is highly recommended that S-LCA practitioners report about their practices so guidelines may be developed.

After modeling the actual system, it is relevant to ask the questions:

1. Where are the processes located in the World?
2. a) What is (or who are) the enterprise(s) or organization(s) involved in each of the processes?
   b) Who are the other stakeholders (society, local community, workers, consumers, value chain actors) involved in each of the processes?

While it is possible to conduct hotspots' assessment with little information about the enterprises or organizations and general information about the location, it is not possible to assess the detailed impacts.

Information on enterprises, organizations and stakeholders will not be available for all of the processes involved in the product system. That does not mean that a S-LCA cannot be conducted. Rather, this implies that when results will be reported, those processes about which only a small amount of information is known need to be indicated, e.g. by applying larger uncertainty bounds on the data from these processes. With generic data, hotspots assessment can be conducted for those processes. In some cases, it may even be that the "average mobile phone" is the scope of the study and generic, rather than site-specific data, is the best.

40 Note: for example, the article by Hunt and Franklin (1996).

4.2.5.3. Generic data and site specific data collection

After setting the system boundary, the S-LCA practitioner needs to decide where data needs to be collected on site. Site specific data refers to data collected for a specific process, occurring in a specific enterprise, in a specific location with those stakeholders involved or affected. Site specific data does not mean that the data is all collected on-site as data might be collected elsewhere (e.g. town office, etc.).

Generic data means data that have not been collected on site (with the stakeholders). Even data that are collected from other manufactures of the same kind of product, in the same country as the one of the life cycle stage being studied, are still considered generic. They may not be representative of the impacts of the particular supply chain. Since behaviors are so important in social impacts assessment, it is important to know the site-specific information.

There is a need for prioritization in conducting a S-LCA because it is very costly, time consuming, and often not relevant to collect data on site at every organization involved in the production, use and disposal of a good or a service. Priority setting may benefit from taking in account (depending of the goal of the study) the sphere of influence of organizations that are mandating the study and the relative importance of life cycle phases of the product studied. The relative importance may be determined according to the added value of each of the processes in the product system, the worker hours and/or other relevant activity variables.

Site-specific data collection may be determined as a function of the sphere of influence of the organization for which the product is being assessed. Hence, the evaluation may include generic assessment for life cycle stages that are not under the organization's influence. Specific assessment may be included when entering the sphere of influence of the organization producing the product assessed. However, it should be noted that spheres of influence and importance do not necessarily coincide. The Global Reporting Initiative boundary protocol (GRI, 2005) offers valuable insights for the process of setting boundaries. It recognized that boundary setting is also a management exercise and involves considering legal, accounting, scientific and political criteria.

The criteria used for prioritizing may also be used as criteria for cut-off. Decisions on cut-off are hard to make, as there is little previous experience on where impacts are generally insignificant. Cut-offs still need to be made to make S-LCA studies possible, though.

There is a difference between primary data and site-specific data. Primary data is gathered during the study in question, rather than published prior to the study. Data may be gathered from a sample of unit processes, in order to estimate the average parameters for a group of unit processes. Primary data estimated from a sample of processes in the group is not site-specific.

4.3. Life Cycle Inventory analysis

Goal of the section:
This section details what needs to be done when conducting the Inventory phase of a S-LCA.

What is to be achieved in Life Cycle Inventory analysis:
Data is to be collected for 1) prioritization, 2) hotspots assessment, 3) site specific evaluation and 4) impact assessment (characterization).

The data is to be validated and the system boundary refined. The data is related to the functional unit and aggregated in some cases.

Guidance:
The life cycle inventory phase consists in a set of actions summarized below:

- To collect data on unit processes activity variable.
- To collect data for hotpots' assessment.
- To proceed to iterative refinement of system boundary based on screening and activity variable information.
- To collect primary data.
- To collect data for characterization.
- To relate data to functional unit and aggregation when applicable.

4.3.1. General

The inventory is the phase of a S-LCA where data are collected, the systems are modeled, and the LCI results are obtained. With a definition of the goal and scope of the study, an initial plan for conducting the inventory phase of the S-LCA is available. Adhering to the following operational steps when performing the life cycle inventory is suggested:

1. Data collection (for prioritizing and screening, using generic data, hotspots assessment)
2. Preparing for main data collection
3. Main data collection
4. Data needed for impact assessment (characterization)
5. Validation of data
6. Relating (main) data to functional unit and unit process (when applicable)
7. Refining the system boundary
8. Data aggregation (when applicable)

1) Goal and Scope

See section 4.2.1

2) System boundary delimitation (generic and specific assessment)

Based on the definition of the functional unit, the product system is modeled and system boundaries are set and described. An inventory for a S-LCA and an E-LCA is the bringing-together (culmination, summing up) of life cycle inventory information [based on elementary flows] over all the unit processes linked by product flows as delimited by the system boundaries.

The most time-consuming step in the inventory consists of collecting the necessary data needed to verify how the organizations related to the production chain perform on social and socio-economic aspects.

Perhaps ideally, a place-specific analysis would be carried out by visiting each one of the organizations providing any significant input to the unit process in which the reference flow is defined. But this would be far too expensive and time consuming, even with a limited chain, and it would often be irrelevant.

But even in an ideal world, where resources would be available to comprehensively study the complete range of social impacts for every process, and where deadlines would not be tight, prioritization and estimation of the relative importance of all the process of the product system would still be relevant to guide data collection and allocation of efforts in the S-LCA study (notwithstanding presentation of results).

The number of visits could be limited using statistically sound random checks, but this implies the risk of overlooking serious problems and is therefore considered too hazardous. Therefore, a cost-efficient system including hotspots assessment, desktop screening and a limited number of on-the-spot visits represents a promising approach. Thus prioritization plays an important role in S-LCA.

Together, activity variable information and social hotspots assessment results provide information that can guide the decision process concerning if and where to conduct case specific assessment. The use of activity variables provides a first set of information on the relative importance of the unit process. A hotspots assessment provides additional information on where the issues of concern may be the most significant in the product's life cycle.

a) First step of data collection:
i) data that needs to be collected - where are the unit processes located (country, region, community) and, when possible, which organizations are involved?
ii) data that may be collected - which activities are variable (worker hours or value-added by unit process)?

Once the product system is mapped and boundaries are set (note that LCA is an iterative process), the S-LCA practitioner needs to find where the processes are located and which organizations are involved. The same level of detail in the identification of specific organizations may not be reached for all unit processes of the life cycle.

In order to provide a relative indication of the importance of different unit processes in a product's life cycle, which is very helpful for prioritization, it can be relevant to map a common "activity variable" to all unit processes. For example, one may consider how many worker-hours are located in different processes in the supply chain or what the added value is for these processes. Such information is helpful to prioritize processes for data collection, deciding where data needs to be collected on-site and where generic data is adequate.

For this purpose, data on worker-hours and/or added value (or other chosen variables) must be collected. With gross information on location (country, region) of the unit process it is possible to access this information, mainly from national statistical agencies.

However, one should notice that this information remains indicative because worker-hours and/or added value do not by themselves say anything about the importance of social impacts. Furthermore, errors may occur, as shown in the following examples:

- If wage rates from high-wage countries are used to estimate worker-hours in low wage countries worker-hours in the low wage countries will systematically be under-estimated.
- Unpaid labor and informal work will not show up in estimates of worker-hours derived from economic data.

The activity variables are our way to represent the product system in a way that gives us an idea of the relative significance of each unit process in the whole system. Processes, either internal or external to the firm, can be related to the activity variable even if the activity variable per se relates more specifically to one or the other kind of processes.

For example, we can still use worker hours to help decide where it is most beneficial to do field data collection. Community impacts may be more important if there are a higher percentage of hours being worked at one unit process. It can also be interesting to express the impacts related to processes external to the organization by the percentage of worker hours in the life cycle of the products. For example, it could be decided to express in the percentage of worker hours of the product's life cycle, the increased access to resources that local communities (all along the life cycle) have benefited from. For example, on 75% of the worker hours of the product X life cycle, the local people have benefited from an increased access to resources.

b) Second step of data collection: Where and what are the hotspots of the product's life cycle?

The second step of data collection consists of a generic analysis that gives an overview of the social problems in the area (country, region) where the largest input to the life cycle of the product comes from. Eventually one can also get to a more precise assessment coupling regional information with data on the industrial sector (e.g. the practices of the textile sector in Cambodia). There is not yet an exhaustive overview available of all generic data relevant to a S-LCA within industrial sectors per country, but research groups are working on this. As for the environmental LCA, the generic approach produces a hotspot assessment.

For the time being, there is no S-LCA database available to help screening for hotspots. S-LCA research and tools evolve rapidly, so it is foreseen that this will change in the near future. It is also probable that generic analysis tools may be available to practitioners in the future and added to E-LCA software.

Box 4

Social Hotspots

Social hotspots are unit processes located in a region where a situation occurs that may be considered a problem, a risk or an opportunity, in relation to a social theme of interest. The social theme of interest represents issues that are considered to be threatening social well-being or that may contribute to its further development.

Social themes of interest include but are not restricted to: human rights, work conditions, cultural heritage, poverty, disease, political conflict, indigenous rights, etc.

However, for the moment, S-LCA practitioners need to conduct the desktop screening themselves, searching for information through the web and through literature surveys as well as through interviews (e.g. with NGOs, Unions, etc.). This is done to determine for which unit processes hotspots are found and hence prioritize where data needs to be collected on-site. Data quality is also a challenge faced when conducting a hotspot assessment.[41]

Hotspots assessments do not cover many of the potential beneficial impacts. A hotspots assessment mostly provides information about where it is more likely to find controversies and where problems in human and worker rights compliance are more likely to be found. This may also help to identify the greatest improvement potentials. Uncertainty levels for social hotspots assessment can be assessed in the future in order to indicate how valid and reliable a hotspot assessment is. For example, if data is available for the country, region sector, process and raw material for a set of social themes (e.g. child labor), the uncertainty level is lower than if only country and wider sector information is available. If the goal of a S-LCA study is to conduct a generic assessment, e.g. of a type of product, a specific supply chain would not then be considered and generic data would be used.

When hotspots assessment become mainstream, classification of organizations in different risk groups will become easier to do. If organizations seem to be high-risk, on-site visits are organized. In some cases, organizations with lower risks can be visited on the spot. A statistical method could then be used to make the choice.

3) Preparing for main (third step) data collection

Once decisions have been made about where site specific data needs to be collected and for which unit processes generic data are sufficient, practitioners can get ready for the main data collection on social and socio-economic inventory indicators.

Data collection is guided by the subcategories selected during the goal and scope. Hence, in order to develop questionnaires, search for data on the Web, and conduct interviews, it is essential to have a good understanding of what information is needed, on which subjects, and what is the best way to access it (See section 4.1). Inventory indicators can then be chosen and strategies for data collection can then be developed.

41 Please see section 4.3.3. for more information on data quality.

Box 5

Inventory indicators

Inventory indicators provide the most direct evidence of the condition or result they are measuring. They are specific definitions of the data sought. Inventory indicators have characteristics such as type (eg. qualitative or quantitative) and unit of measurement. The methodological sheets, available on the Life Cycle Initiative's website, provide examples of inventory indicators for each subcategory.

Data collection for desktop screening may be conducted by:

- Literature review
- Web search

And site specific data collection may be carried through social audit that may involve:

- Auditing of enterprise documentation (e.g. payrolls, management systems)
- Auditing of documentation of authorities and NGOs
- Participative methodologies
- Directed and semi-directed interviews
- Focus group
- Questionnaires and surveys

4) Main data collection

In order to provide a more detailed picture of the production chain's social impacts, in depth screening and monitoring is necessary and this is the third step of data collection. It is possible that some of the hotspots or the bottlenecks identified in the generic analysis end up not representing any problem in the production chain. On the other hand, problems can appear where generic analysis did not suspect them. Not all enterprises active in a country with a high rate of forced labor make use of forced labor. But it is perfectly possible that an enterprise situated in a country where freedom of association is part of the legislation and the culture is known for anti-union practices.

The organization's specific information is first gathered through a desktop screening. This is a research method carried out according to qualitative and transparent written procedures. Most institutes doing research on sustainable performances of organizations use this method following the requirements of the Voluntary Quality Standard for SRI research.[42] These procedures contain the search of controversies on the organization by collecting data on the web, in literature and in various specialized databases. Desktop screening develops further and more precisely the situation pertaining to a unit process organization in the life cycle of the product and documents it. Thus, the chain actors where problems seem to occur can be identified. Here, notice should be taken to also identify possible positive impacts.

Web-based reporting (and bottom-up reporting) of organizations on social criteria and attributes can also represent an interesting avenue to improve data availability while reducing cost.[43]

Site-specific data is being collected through social audits. Social audits conducted in S-LCA analyze the relationship between an organization (at the location where the unit process of interest is found) and its stakeholders (e.g. national government, community representatives, unions and workers' representatives, elected officials, workers, consumers, NGOs). Data collected on site may be generated through document auditing, interviews, questionnaires, participatory evaluation, etc.

Thus the relevant stakeholders of the organizations have to be consulted, with priority to the union representatives representing the workers of the organization. Defining the relevant stakeholders (e.g. categories of employee, local community key stakeholders) and contacting them can be difficult. Some written information can also be asked for directly from the organization, such as payrolls, working hours, excess hours, and health and safety measures.

42 See for more information **http://www.csrr-qs.org/**

43 One proposed system is Earthster, for more information visit www.earthster.org

The visits (or social audits) should be carried out following a well-defined method.[44] The data collection on site as part of the overall monitoring should be done by experienced persons familiar with the local language and the cultural susceptibilities. During the visits, it is not just the management and the employees that are interviewed. The working places and eventually the boarding houses will be visited. Relevant stakeholders such as trade unions are always to be consulted. A complaint procedure could also be installed, giving workers, unions and other stakeholders the chance to contact the monitoring organization or the LCA practitioner directly.

The first part of the monitoring on the spot may consist of the verification of the data provided by the organization. The next step will be to conduct an assessment, that may include interviews and observation of the social and socio-economic performance of the organizations related to the production chain, following best practices and applicable standards and guidelines.

Triangulation of data in social and socio-economic assessment is suggested. That means that information collected from one group of stakeholders needs to be compared/contrasted/put in perspective with information collected from other groups of stakeholders.

For example, when collecting data about freedom of association, researchers may decide to use the following as an inventory indicator: obstruction to the right to organize. On site, interviews might be conducted with representatives of the enterprise (CEO or Human Resources officers). The data collected should be compared and contrasted with information collected from different groups of workers and community representatives, and also with reports found on the web. Generic data could also be collected for hotspot assessment of freedom of association. The data collected would be about evidence or risk that this right is not respected in a country, region, sector etc. The data could be collected, for instance, from the ILO reports of the committee on freedom of association.

a) Note on data (fourth step) needed for impact assessment

In addition to the data that must be collected on the situation (e.g. wages), data needs to be collected on background information that may be needed to assess impacts at the characterization step of impact assessment (e.g. living wage in the country, minimum wage in the country, average wage in the sector, etc.).

Databases may also be developed that will provide this information to practitioners but, for the moment, people conducting S-LCA studies need to also collect such background data on a case by case basis. This topic will be addressed in the social and socio-economic Life Cycle Impact Assessment section 4.4.

5) Validation of data

ISO 14044 (2006) requires that "A check on data validity shall be conducted during the process of data collection to confirm and provide evidence that the data quality requirements for the intended application have been fulfilled".

The validation of data is further discussed in 4.3.3.

6) Relating data to functional unit and unit process (when applicable)

The ISO standard requires that:

> An appropriate flow shall be determined for each unit process. The quantitative input and output data of the unit process shall be calculated in relation to this flow. Based on the flow chart and the flows between unit processes, the flows of all unit processes are related to the reference flow. The calculation should result in all system input and output data being referenced to the functional unit.

When S-LCA is conducted with qualitative data, data may not necessarily be expressible per unit of process output. Even quantifiable variables may be difficult to interpret when expressed per unit of process output from a social perspective. Other ways of summarizing the share of the life cycle that possesses (or not) specific social attributes may be relevant as discussed in the section on handling of co-products.

44 See for more information 1) Commitee on Monitoring International Labor Standards, National Research Council (2004) and 2) Monitoring guidance and compliance benchmarks. (2007) Fair Labor Association. **http://www.fairlabor.org/about/monitoring/compliance**

7) Refining system boundary

Sensitivity analysis is a technique to assert whether a change (e.g. the inclusion or exclusion of a unit process) to the system would change the result above a certain threshold (in quantitative sensitivity analysis a 1% or 5% change is often regarded as a significant change). Sensitivity analysis may also be performed on qualitative data, essentially estimating if the inclusion of a process would affect the overall result.

ISO 14040 (2006) requires that:

> Reflecting the iterative nature of LCA, decisions regarding the data to be included shall be based on a sensitivity analysis to determine their significance, thereby verifying the initial analysis outlined in 4.2.3.3. The initial system boundary shall be revised, as appropriate, in accordance with the cut-off criteria established in the definition of the scope. The results of this refining process and the sensitivity analysis shall be documented. This analysis is useful to limit the subsequent data handling to those input and output data that are determined to be significant to the goal of the LCA (ISO 14044, 2006).

It is recommended that S-LCA studies attempt to characterize the sensitivity of their data due to system boundary decisions.

8) Data aggregation

Aggregation of life cycle inventory data should not be done in a way that leads to loss of information about the location of the unit processes. This is important because the impact assessment may need to take this location information into account. Aggregation may be done at the impact assessment phase of the study.

Data collected will be assessed at the impact assessment phase of the study.

4.3.2 Handling co-products

Analyzing the life cycle of goods and services frequently leads to a situation where the system under consideration generates several valuable products. If assessing the impacts from only one of these products, it is necessary to modify the system in such a way that it produces only this product as its valuable output. In attributional modeling, this is preferably done through separate modeling or system expansion, as described below. In consequential modeling, the system is limited to the processes that change as a consequence of changing the demand for the valuable output in question.

Typical examples of systems with multiple product outputs are:

- The use of agricultural products like fruits from coconut palms where the water, the fiber from the husk of the coconut and the oil extracted from copra are used;
- The electrolyses of sodium-chloride which lead to sodium, chlorine and hydrogen;
- The co-generation of power and heat in a power plant;
- Reuse and recycling, when material of the product system under study is recycled in another product system.

The ISO standards for LCA (ISO 14040/44, 2006) define allocation as "Partitioning the input or output flows of a process or a product system between the product system under study and one or more other product systems." Ways to deal with multiple product outputs are listed below, in order of preference within the ISO LCA standards:

- Avoid allocation by gathering data for the production of each of the separate products, and modeling their production separately;
- Avoid allocation by "giving credit" to the main product for a presumed reduction in the need for other processes to produce the co-products;
- If allocation cannot be avoided, then first try to model explicitly how the process impacts are related causally (what ISO calls "physically related") to the levels of output of each product;
- If causal modeling is not possible, then allocate the process impacts on the basis of the share of revenue coming to the process for each of its product outputs,[45] or some other basis.

A S-LCA reports social and socio-economic *impacts* over life cycles. If the impacts can be logically expressed *per unit of product output from a process,* then the ISO guidance and order of preference on allocation appears relevant. There is no reason to propose a deviation from this guidance in such cases.

For S-LCA results that cannot be expressed per unit of process output, quantitative allocation no longer occurs. However, ideas from the ISO order of preference are still worth bearing in mind, as the following discussion illustrates.

A S-LCA can also include types of reporting over the life cycles of products which do not aim at *assessing impacts* over these life cycles.[46] Other kinds of reporting across life cycles can include summarizing shares of supply chains and/or life cycles that have *attributes* or properties of interest. For example, users of S-LCA may wish to know about the policies of enterprises. They might want to know whether the final brand owner is a known violator or exemplar in relation to some norm of corporate behavior. They may also wish to report what share of the output or value-added or employment in a life cycle or supply chain comes from organizations with these attributes.

45 Revenues for a product are understood as price times quantity. The selected allocation basis needs to be able to discern the single, to-be-allocated products, and have at the same time a credible relation to social impact according to goal and scope of the study. This will often be the case for revenues, since price and quantity for products will be available, and both will often relate to social impacts. This is rarely the case for a measure like working hours, since they will, for multi-product processes, not be discernable for each of the products.

46 The same can be true for environmental LCA, if we include environmental life cycle attribute assessment.

Attributes are different from impacts, in the sense that they are less clearly related to the levels of product output from a process. An enterprise either follows or violates a norm; this violation is not logically expressed per unit of product output. Instead, we could say that all products from processes owned by this enterprise come from processes owned by known violators of the norm. In this example, it makes no sense to "allocate" the enterprise property among the multiple products from the enterprise.

Note that even with life cycle reporting about attributes, there still can be cases where ISO's recommended step 1 -- using more detailed data to sub-divide an aggregated process – may be valuable. If an enterprise produces tomatoes and strawberries and if the tomato laborers are allowed to organize while the strawberry workers are not, this may be relevant to some practitioners and users of S-LCA. Some users may be satisfied with a report that states that their tomatoes were produced by supply chains that allowed workers to organize. Other users may wish to hold the tomato producers accountable for (and report) the fact that the tomatoes come from an enterprise which bars even some of its employees from organizing, regardless of whether these employees are involved in the product life cycle in question or not. In either case, we see that S-LCA users are going to wish to "avoid allocation" of this attribute to the products on a per-unit basis. Rather, they must be specific about the attribute: whether it is an attribute of the enterprises owning the processes or an attribute of the workers involved in the production process.

4.3.3. Data Quality

It is important to address the data quality and integrity, as this is fundamental to ensure the reliability and validity of the findings, in order to reach useful conclusions. In S-LCA as in E-LCA, data quality can be verified quantitatively or qualitatively. There is no guidance document available at the present time addressing the question of data quality requirements for social and socio-economic data in S-LCA. Despite the fact that methods to address and experience in characterizing social and socio-economic data quality are still developing, some general considerations are discussed in this section. A set of preliminary criteria is proposed and described, specific challenges for generic and site specific data are discussed and a data quality management option is presented.

Preliminary list of criteria

A preliminary list of criteria that may be used to assess the data quality would be:

1. Validity
   Do the data collected and the indicators used provide information on what is intended to be measured?
2. Relevance
   Are the right data and indicators being used to measure what is meant to be measured?
3. Measurement methods
   Are the measurement methods used to generate and/or collect the data appropriate?
4. Completeness
   Does the data gathered cover the needs of the study?
5. Accessibility/Documentation
   How well is the data documented?
6. Uncertainty
   How certain are the results?

Validity

The basic premise is that prior to measuring something, we need to think hard about what it is that we wish to measure. In more general terms, we should clarify our aims and purpose before acting on them. Because there is no set of indicators developed for every one of the subcategories and because the best indicators to use might be different from case to case, S-LCA practitioners will need to reflect on the validity of their inventory indicators to measure the subcategories for each study.

Conducting social assessment involves assessing concepts. Concepts may be Living Wage or Forced Labor but in order to be correctly assessed they need to be well defined. In the context of S-LCA, concepts are the subcategories. Once the concepts are defined indicators are developed.

“An indicator is said to be valid when the fit between it and the underlying concept is close. Although this is an elementary rule of empirical research, it is by no means simple to observe. Concepts are abstract, while measurement of indicators is concrete.” (Jacob, 1984)

Relevance

Data quality depends on the appropriateness, or relevance, of the data used. In S-LCA, data that accurately describes the social conditions of production for a process in Morocco will not be as relevant for the same process in Mexico. Likewise, data from 1992 may not be appropriate when the goal is to describe the social situation of a current condition. Other aspects of a dataset that may render it less relevant to the study are the sample size and the representativeness of the sample population. S-LCA practitioners should seek to characterize the relevance of the study’s data with Data Quality Indicators.

Measurement methods

The measurement procedures are general methods of measurement (e.g. interview, questionnaires), specific features of such methods (e.g. directions to respondents, item order, item wording) and conditions of administration (e.g. respondents are assured anonymity) (Jacob, 1984).

The measurement procedure should be scrutinized in the context of the overall aim and setting of the study and in the light of the specific properties of the measure in question.

Completeness

Data completeness refers to an indication of whether or not all the data necessary to conduct the assessment is available.

Accessibility/ Documentation

As in all life cycle assessments, documentation of data sources serves an important role, providing a sound basis for communication of data quality issues. Documentation needs will vary depending on the data source. Data collection from primary sources should document data collection methods and conditions that may have affected measurement results. For secondary public data sources, documentation should be clear enough for a third party to independently reproduce the dataset.

Uncertainty

Uncertainty is the general term we use to cover any distribution of data caused by either random variation or bias. Uncertainty expresses the general problem that an observed value can never be exactly reproduced, but when an adequate number of observations have been made, certain characteristic features of their distribution can be described, such as mean and standard deviation.

Each step of the assessment will introduce new uncertainty factors into the study and its results. For example, some uncertainty might be found when collecting the worker hours because of data gaps which ended up being estimated. In the hotspots assessment step, we might have to rely on data that were generated five years apart for different unit processes of the product life cycle. When aggregating inventory indicators in one composite index (subcategory) we will also introduce some more uncertainties notably because of the characterization model that will be used.

With more research and more documentation drawing from practice, it will become clearer where the uncertainty mostly comes from in S-LCA. For the moment, one idea would be to document qualitatively uncertainty at the unit process level and according to which type of data collection is used and how data are aggregated.

Specific challenges for generic and site specific data

Data may be collected from secondary sources like UN or OECD databases or provided by the industry or it may be collected directly using a variety of instruments. Depending on the way data are generated or acquired, specific challenges will arise.

Challenges for generic and secondary data

Using generic data in studies where site-specific data is preferred presents specific challenges. It may be necessary to use secondary data (generic or site-specific). However, these may have been gathered for a different purpose. Sometimes they do not relate well with the concept being measured, sometimes the context has changed and the way the data collection was conducted is no longer appropriate. Sometimes the collection agency transforms the data in a way that invalidates it and sometimes parts of the necessary data are just not available. Sometimes the collection agency is not reliable because the persons collecting the data are making mistakes, the change in the collection procedure is creating errors, or the category being used by the collection agency is inappropriate.

An example is the data obtained from national censuses:

> "A vast majority of social indicators found in international databases are based on information obtained from national censuses. It is well-known that many countries do not have the resources to conduct accurate censuses. No country conducts a yearly national census and some countries conduct them at irregular intervals. Data for the intervening years have to be estimated. Given these and a number of methodological problems, the data tend to be incomparable both between countries at a given point in time and within given countries over time. As a consequence, differences among countries in the values of social indicators are difficult to interpret. Yet, these problems do not provide grounds against the use of social indicators per se, but grounds for attempting to improve their reliability (McGillivray, 2007)."

Some studies may have a scope where generic data are the most relevant data.

The following distinctions will also often be convenient in the case where generic or secondary data is used:

- *Geographical differences.* How well does the data for a unit process reflect the geographical scope set by goal and scope (region, country, facility…)? Data cannot be transferred easily from one country to another in S-LCA.
- *Temporal.* How well does the data reflect the temporal scope set by goal and scope?
- *Further Technological differences.* How well does the technology of the process fit when compared to the technology intended by goal and scope?

Some other validation steps for secondary data include checking for data outliers, cross-checking several data sources, benchmarking against industry averages (Weidema B. et al., 2001), and hypothesis checks. The approach to validation may differ for the different subcategories and inventory indicators.

For example, suppose a practitioner has data on the number of work-hours in an industry and would like to validate this information. She could take advantage of the relationship: annual work hours = number of employees(e) * employee work hours per year(h). If she can gather independent data on either the number of employees(e) or the works hours per year(h), it is then possible to solve for the missing term. She can then assess whether the result is reasonable.

The credibility of sources is very important because reliability is very much a function of the characteristics of the organizations that produce and publish the data.

Challenges for site specific data

Site specific data are data collected in the context of the S-LCA. They may be collected internally, at the organization level, by a S-LCA practitioner, or by an independent agency. Any bias related to the measurement methods should be discussed. For example, answers received in interviews with factory employees are subject to a number of biases that should be considered and described in the study.

Check list for evaluation of site specific data quality

- Validity and reliability of the measurement methods (e.g. questionnaires)
- Context or conditions of administration of the measurements procedures
- Triangulation of data

Data quality management

For a practical data quality management, defining quality criteria for relevant aspects of data quality (for the social assessment) is recommended. One example would be the age of data and the difference between the age of data and the required time coverage of a study, according to goal and scope.

The next step is then to define evaluation results for these criteria on an ordinal scale (e.g. from 1 to 5). Again for the criterion "time difference," possible evaluation rules could be: (1) less than two years; (2) two to four years; (3) five to ten years difference, (4) more than ten years difference and (5) age of data unknown. Ordinal evaluation rules and the data quality assessment criteria can be combined in a matrix, which is commonly known as pedigree matrix, following an idea for uncertainty management by Funtowicz and Ravetz (1990).

For life cycle approaches, such a pedigree matrix was first proposed by Weidema & Wesnaes (1996) for environmental LCA and recently adapted to Eco-Efficiency and Cost Assessment (Ciroth A., 2008)[47]. This cost assessment matrix is closely related to the solution by Weidema and may therefore be combined in a study dealing with costs and environmental life cycle impacts.

The pedigree matrices have the benefit of converting qualitative assessment results (as the difference of the needed time coverage of data, according to goal and scope, compared to their actual age) into quantitative figures (scores from e.g. 1 to 5, with 5 being the worst). The evaluation is fast to apply and results may even be aggregated over different criteria in order to arrive at a more aggregated data quality indicator (one even may arrive at a fully aggregated indicator). However, for social Life Cycle Assessment, no matrix has been proposed so far, making it a candidate for further research and development.

47 Ciroth, A.: Cost data quality considerations for eco-efficiency measures, Ecol. Econ. (2008), doi:10.1016/j.ecolecon.2008.08.005

4.4. Life Cycle Impact Assessment

Goal of the section:
This section details what needs to be done when conducting the Impact Assessment phase of a S-LCA.

What is to be achieved in Life Cycle Impact Assessment:
The classification, aggregation and characterization of data according to performance reference points will be achieved.

Guidance:
The Life Cycle Impact Assessment phase consists in a set of actions summarized below:

- To select the impact categories and subcategories, and the characterization methods and models;
- To relate the inventory data to particular sLCIA subcategories and impact categories (classification);
- To determine and/or calculate the results for the subcategory indicators (characterization).

4.4.1. General

This section presents the general framework for a social and socio-economic Life Cycle Impact Assessment (sLCIA) following the general guidelines of ISO 14 044 (2006). Some adaptations of the norm will be pointed out when necessary for the specific purpose of S-LCA. Impact assessment methodologies are under development and S-LCA is an *open* field for future research.

Impact Assessment (sLCIA) is the third phase of a S-LCA. The purpose of sLCIA is to provide a combination of:

(a) aggregating some inventory data within subcategories and categories; and
(b) making use of additional information, such as internationally accepted levels of minimum performance, to help understand the magnitude and the significance of the data collected in the Inventory phase.

Therefore, sLCIA may provide assessment of social and socio-economic impacts that can range from specific to very general, from final to preliminary, depending on which level of precision is reached in the summarization and the interpretation, which in turn is influenced by data availability. It includes steps of basic aggregation as well as meaning assessment, in addition to possibly estimating social impacts.[48] Some sLCIA methods have been developed to provide estimates of social impacts directly at the unit process activity. Others provide estimates of how unit processes can lead to potential human health consequences through socio-economic pathways. And more generally, several proposed and demonstrated sLCIA methods provide *summaries* and *interpretations of the social significance* of the data collected at the Inventory phase.

In E-LCA, the Environmental Mechanisms are the models representing the causal pathways which link the Inventory flows through natural or social processes through which the Inventory flows to potential impacts on ecosystems, resources, and human health. In S-LCA, the same terminology is used, although the interpretation being proposed may be more general than cause-effect modeling, as described above. Thus, we may use the term "social and socio-economic mechanism"[49] to refer to the modeling and analysis that derives sLCIA results from inventory data.

48 The term social impact is sometimes defined narrowly to express only the idea of "direct/causal social consequences of an activity" therefore not including social change processes. Here the term is used in a broad manner encompassing the notions of effects, consequences, social change processes and presence of social attributes.

49 The appellation Socio-Economic Mechanism is chosen in respect to the term Environmental Mechanism used in ISO 14 044 (2006).

The sLCIA phase consists of the three mandatory steps identified in ISO 14044 (2006) for LCIA, which allow to trace the Inventory data through the relevant social and socio-economic mechanisms to define a social and socio-economic Impact (see Figure 4). Those three steps are as follows:

- Selection of impact categories and characterization methods and models;
- Linkage of inventory data to particular sLCIA subcategories and impact categories (classification);
- Determination and/or Calculation of subcategory indicator results (characterization).

Those three steps are defined in greater details in the following sections.

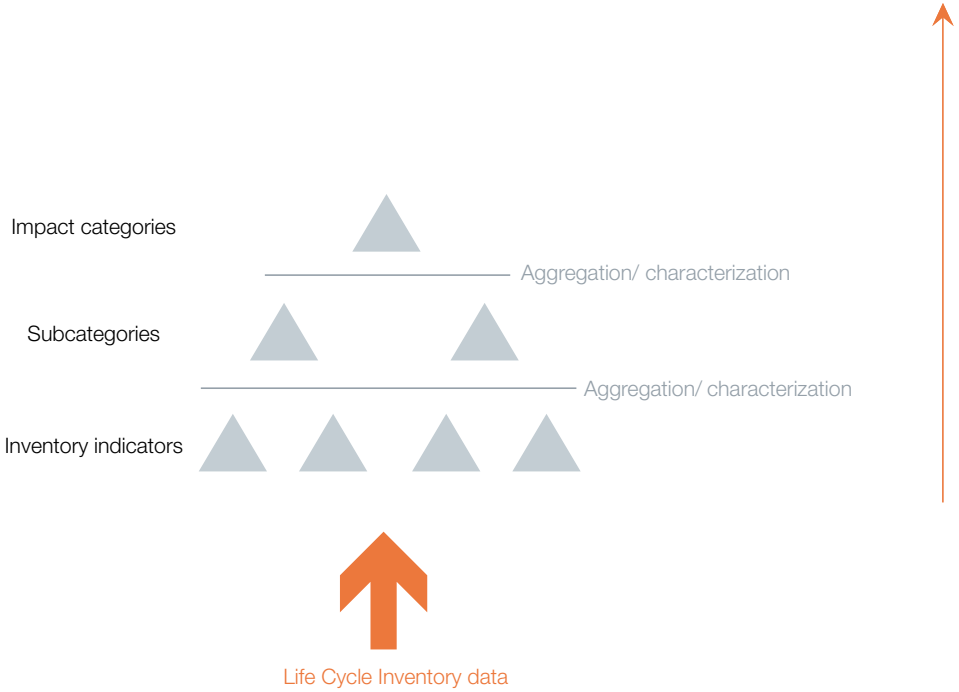


Figure 9 – Concept of Subcategory (inspired by ISO 14 044 (2006))

4.4.2. Selection of impact categories, subcategories and characterization models

The choice of impact categories, subcategories and characterization models shall be made in accordance with the goal and scope of the study.

4.4.2.1. Impact Categories

Impact Categories are logical groupings of S-LCA results, related to social issues of interest to stakeholders and decision makers. For the time being, stakeholder categories and subcategories are the basis on which to build. More experience needs to be gained in order to determine one, or several, final sets of generally accepted impact categories. In E-LCA, two types of Impact Categories are defined: Endpoints and Midpoints. The Endpoint category seeks to represent the environmental damages caused to an Area of Protection, e.g. the biotic natural environment or human health. The midpoint category aims to cover an environmental problem that stands somewhere between the Inventory (i.e. an emission) and the final damage on the Area of Protection. The evaluation of the impact follows a cause-effect chain from the inventory flows to at least Midpoint indicators, and optionally continuing with further cause-effect modeling to assess Endpoint results.

Both in environmental impact assessment and when evaluating social and socio-economic impacts, situations occur where such cause-effect relationships are not simple enough or not known with enough precision to allow quantitative cause-effect modeling.

Two types of social and socio-economic impact categories can be identified. Type 1 impact categories aggregate the results for the subcategories within a theme of interest to a stakeholder, e.g., Human Rights. Type 2 impact categories model the results for the subcategories that have a causal relationship defined on the criteria, e.g. Autonomy.

Impact Categories (type 1) used in S-LCA will correspond to the goal and scope of the study and represent social issues of interest that will be expressed regarding the stakeholders affected and may cover health and safety, human rights, working conditions, socio-economic repercussions, cultural heritage and governance.[50] The subcategory indicator results are aggregated into impact category results. All the aggregation formula (characterization) must be transparent. The information can be aggregated on one resulting end-category that may be Human Well-being or Fairness of relationships. It should be noted that, for the time being, there are no characterization models between subcategories and impact categories (type 1) that are generally accepted by S-LCA practitioners.[51]

Impact categories (type 2) correspond to a model of the social impact pathways to the endpoints human capital, cultural heritage and human well-being, the latter with the midpoints health, autonomy, safety, security & tranquility, equal opportunities, participation & influence, resource (capital) productivity.[52] To do so, one needs to model from subcategory results to impact categories on human well-being, with or without aggregating the information at the impact category (type 1) level. The information could also be modeled and/ or summarized (aggregated) with one result for Human Well-Being.[53] For the time being, the causal models in social sciences are generally not well developed.

One could also choose to aggregate the results over the life cycle with Life Cycle Attribute Assessment using the inventory indicators or subcategories results and summarize it for the entire life cycle of the product e.g., 75% of the worker hours of the life cycle of the product are known to be child labor free. Practitioners should always keep in mind that the disaggregated results should be presented along with the aggregated results, in order to avoid that information being lost. sLCIA results are the final values calculated within the Impact Categories (type 1 or 2) or aggregated with Life Cycle Attribute Assessment. Following eLCIA terminology, we refer to the calculation methods used to calculate subcategories results in an sLCIA as characterization models.

We recommend that the Annex 3 list of subcategories set a minimum of issues assessed for S-LCA and that choices be well described and documented. This aims to prevent using S-LCA results on a few limited topics for social marketing aims while not addressing core issues.

4.4.2.2. Subcategories

Subcategories (e.g. Fair Salary, Hours of work, etc.) aim to represent impacts within an Impact Category (Working Conditions of the stakeholder workers, for instance). In E-LCA, the number of impact categories is limited by practicality. Subcategories are used because of the tendency to split categories because they are too heterogeneous and do not allow for scientifically valid aggregation. The same situation occurs in S-LCA. The subcategories are the socially relevant characteristic or attribute to be assessed (i.e. fair salary). (For topic, category and indicator definition see discussion in section 4.1). Several subcategories may be used to cover an Impact category.

Subcategories of an Impact Category seek to describe the overall meaning of the indicators used to represent this subcategory. This is done through a set of indicators used to represent this Category (e.g., Impact category: Working conditions, Subcategory: Social security and benefits, inventory indicators: percentage of employees covered by 1) health insurance, 2) retirement insurance, 3) paid maternity and paternity leaves, 4) legal contracts, etc.).

Hence, there may be two weighting/aggregation steps. One that allows passing from inventory indicator results (inventory results) to a subcategory result and one that allows passing from subcategories results to an impact category result. All subcategories should be included in a study.

50 Proposed by Catherine Benoît (2007)
51 Refer to section 4.1
52 Proposed by Bo Weidema (2006)
53 Proposed by Louise Dreyer (2005) and Bo Weidema (2006).

4.4.2.3 Quantitative, semi-quantitative and qualitative Indicators

Social and socio-economic mechanisms can take different forms, and so can the indicators. Because some social and socio-economic impacts might be best captured through qualitative indicators, one can choose between quantitative, semi-quantitative and qualitative indicators depending of the goal of the study and the nature of the issue at stake.

A quantitative indicator is a description of the issue assessed using numbers, for example, the number of accidents by unit process. Qualitative indicators describe an issue using words. They are nominative, for instance, text describing the measures taken by an enterprise to manage stress. Semi-quantitative indicators are categorizations of qualitative indicators into a yes/no form or a scale (scoring system), for example, presence of a stress management program (yes-no).

Quantitative indicators can be directly related to the unit process output as it is the case in E-LCA. Although semi-quantitative indicators cannot be directly expressed per unit of output process, it is possible to assess, in quantitative terms, the relative importance of each unit process in relation to the functional unit. This allows aggregation of final category results in a comprehensive and logical way. One way this can be done is by using Life Cycle Attribute Assessment, a method that defines that the percentage of a supply chain that possesses (or lacks) an attribute of interest to be expressed (Norris, 2006).

4.4.3. Classification

The classification step is the part where the Inventory results are assigned to a specific Stakeholder Category and/or Impact Category. As in E-LCA, the classification is implicitly part of the Characterization Models (Social and Socio-economic Mechanisms) development.

4.4.4. Characterization

The step of characterization involves the calculation of the subcategory result. ISO 14044 (2006) describes this phase as follows: “The calculation of indicator results (characterization) involves the conversion of LCI results to common units and the aggregation of the converted results within the same impact category. This conversion uses characterization factors. The outcome of the calculation is a numerical indicator result.”

In sLCIA, the characterization models are the formalized and - not always - “mathematical” operationalization of the social and socio-economic impact mechanisms. They may be a basic aggregation step, bringing text or qualitative inventory information together into a single summary, or summing up quantitative social and socio-economic inventory data within a category. Characterization models may also be more complex, involving the use of additional information such as performance reference points. Performance reference points may be internationally set thresholds, or goals or objectives according to conventions and best practices. Performance reference points need to be transparent and documented.

There is an important nuance between the E-LCA and S-LCA characterization models. In E-LCA, the characterization model is an objective multiplication between the inventory data and a characterization factor defined in accordance with environmental sciences. When evaluating social information (either qualitative or quantitative), a scoring system may be used to help assess the “meaning” of the Inventory data, based on performance reference points. This provides an estimation of the impact. In contrast to E-LCA, the S-LCA scoring and weighting step might be undertaken at the characterization step (instead of interpretation), which can also be designated as the meaning assessment step.

The models and criteria used to define the characterization factors as well as the scoring and weighting system must be well defined and transparent.

4.4.5. Development of Social and Socio-economic Impact Life Cycle Assessment

The social and socio-economic issues of interest (subcategories) that may be assessed according to these Guidelines are described in the methodological sheets (to be found on the Life Cycle Initiative's website). There is an important need for research concerning the elaboration of social and socio-economic mechanisms. When developing social and socio-economic mechanisms, it is important to keep in mind that there are two approaches for developing subcategories and the associated characterization models, which we might designate as top down and bottom-up approaches.

The top-down approach consists of identifying broad social and socio-economic issues of interest. This includes the inventory indicators needed to assess them and the development of characterization models that translate social and socio-economic inventory data into subcategory results and/or impact category results.

On the other hand, bottom-up approaches attempt to provide summaries of inventory information, which is provided at the organization and process level, asking the appropriate stakeholders what would be relevant summary indicators and aggregation/summary methods according to their perspective. The result is an assessment of local level issues of concern and their relative importance according to the appropriate stakeholders' understanding (workers, community etc.). The top-down and the bottom-up approaches are complementary.

In the impact assessment step of an S-LCA the distribution and share of positive and negative impacts is important to consider. How this should be done is an issue of further research and testing in case studies.

The construction of the subcategories and the related characterization models will inevitably include value judgments and assumptions. There is a strong need to make them as transparent, clearly explained, and as referenced as possible.

4.5. Life Cycle Interpretation

Goal of the section:
To explain what needs to be considered when interpreting the S-LCA results and making conclusions.

What is to be achieved:
Interpretation taking into account all relevant parts of the study.

Guidance:
The Life Cycle Interpretation phase consists in a set of actions summarized below:

- Identification of the significant issues;
- Evaluation of the study (which includes considerations of completeness and consistency);
- Level of engagement with stakeholders;
- Conclusions, recommendations and reporting.

4.5.1. General

Life Cycle interpretation is the process of assessing results in order to draw conclusions (Baumann and Tillman, 2004). In accordance with the goal and scope of the study, this phase has several objectives: to analyze the results, reach conclusions, explain the limitations of the study, provide recommendations and report adequately. ISO 14044 (2006) defines three main steps:

1) Identification of the significant issues;
2) Evaluation of the study (which includes considerations of completeness and consistency);
3) Conclusions, recommendations and reporting.
To which is added:
4) Level of engagement with stakeholders

1) Identification of the significant issues

Significant issues are the important social findings and the critical methodological choices. They include the identification of key concerns, limitations and assumptions made during the study and resulting from the study.

Example of significant issues in S-LCA:

Key concerns may be the hotspots when conducting a generic assessment. It may be the finding of important beneficial social impacts that were not expected. It may be the finding of important human rights infringements at a unit process organization.

Particularly, it is important to stress system boundary choices and the level of detail, from generic to site specific, reached for each of the processes of the product system.

The purpose here is to account for any assumptions made and for the consequences of decisions taken throughout the study.

2) Evaluation

The evaluation can use a range of qualitative, semi-quantitative and fully quantitative approaches. Some key requirements regarding the evaluation process include the performance of a critical review, the documentation of the evaluation process, the actions taken to ensure transparency, and the verifiability of results.

In addition, it is important to establish the reliability of the findings, including issues arising from any significant issues.

Completeness
The completeness aims to assess if all the relevant crucial issues have been addressed in the study and all necessary data collected. It includes evaluation of the indicators and metrics used to draw the conclusions and the assessment of data gaps.

Consistency
The consistency aims to verify the appropriateness of modeling and of the methodological choices according to the defined goal and scope.

3) Conclusions, recommendations and reporting.

Conclusions have to be drawn and a recommendation made, based on the goal and scope of the study. It may be best to start with preliminary conclusions and verify if they are consistent with the requirements set out for the study. If these are not consistent, it may be necessary to return to previous steps to address the inconsistencies. If the preliminary conclusions are consistent, then the reporting of the results may proceed. The reporting should be fully transparent, implying that all assumptions, rationales, and choices are identified. Recommendations are a means to formulate options for actions. Results may be presented differently depending on the intended audience and the ability to support a conclusion. It is suggested to structure the results so that the significant issues based on the goal and scope may emerge.

For example, results can be presented by format decided by the character of the results:

a) Level of details (generic – case specific) and/or
b) Type of data (qualitative - quantitative)

Results can also be presented in respect to analytical purposes

a) High level of risk/hotspots (generic) or impact (case specific), whether positive or negative, of each life cycle step
b) Most problematic social hotspots /impacts in the life cycle
c) Identification of social hotspots/impacts in respect to the sphere of responsibility/influence of the decision maker

Or by the robustness of results

a) Uncertainty
b) Changes in most critical data
c) Changes in scenarios

4) The participation of relevant stakeholders

It is important to report on the participation and involvement of stakeholders in the study, particularly in the case of a case specific study.

5. S-LCA Applications and Limitations

S-LCA is a technique for decision support and learning, a technique to apply when assessing social and socio-economic impacts related to products' life cycles. S-LCA provides information on social and socio-economic performance in relation to a function/benefit provided.

As specified in section 4.2, the goal of the study may be to analyze social and socio-economic performance in the different stages of a product life cycle, to compare two or more different products, or to assess the consequences of a decision to be made.

A S-LCA is applicable when the question concerns social impacts related to a good or a service. When using S-LCA, one should focus on improvement potential and highlight life cycle stages where improvements are most crucial.

S-LCA could be used as a motive to favor enterprise locations where most social negative impacts are already low. However, it could be also used as a motive to favor process locations where investments procure a larger share of positive social impacts, e.g. in developing countries. It is therefore recommended to be aware of those two background assumptions (risk and opportunity approaches). Thus, S-LCA is a methodology that can provide valuable information on social conditions of the production and consumption of products in a transparent, science-based manner.

S-LCA, just as E-LCA, is useful in highlighting trade-offs between different alternatives. One alternative may not be simply better than the other, but S-LCA will give an understanding on under what circumstances/ regarding which issues one of the alternatives is preferable. Performing a S-LCA will give an increased understanding of the system, its impacts and the complexity of the product system.

The technique may be used by enterprises, organizations, academia, NGOs, governments etc. However, those performing a S-LCA need substantial knowledge regarding how to use the technique and how to interpret the results.

S-LCA may be used in combination with other techniques or tools, e.g. in parallel with environmental LCA or as part of a planned intervention. If S-LCA is used in parallel with environmental LCA or LCC, the following two points need to be considered.

First, the calculation basis shall be as consistent as possible. This includes, for life cycle approaches

- consistent system boundaries
- consistent allocation within system boundaries
- consistent data sources

Consistent does not mean identical. Rather, it means that identical evaluation principles are employed, based on goal and scope. For example, a unit process that is relevant for social aspects, but not for environmental aspects, should be included in the "social and socio-economic" system, but needs not be considered in the environmental system. This is similar to LCC which will often consider design and development of a product, while these will be disregarded in environmental LCA.

Second, concerning results, it will be desirable to minimize overlap and double counting between (micro-) economic cost results of environmental LCC, environmental results of environmental LCA, and S-LCA. At least, any existing overlap and double-counting shall be addressed in a transparent manner so that it can be taken into account when considering the results.

The following paragraphs express identified limitations of S-LCA as of today.

Limitations induced by the novelty of the technique

The experience with product assessments focusing on social aspects is still limited. As experience grows by performing case studies and through scientific debate, S-LCA will become increasingly easier to conduct and tools will become available to make it mainstream. Due to the lack of tools (e.g. software), the use of S-LCA may be limited and a large amount of resources will be needed to perform a comprehensive study.

Limitations caused by the difficulty in accessing data

Data collection is a central challenge for current S-LCA, since not many databases exist (as can be expected for a new method). At the moment there are very few databases from which background data can be taken, although information gathered prior to the S-LCA or in another context (reporting, certification, social impacts assessment) can also be used within the S-LCA. That means that collecting all relevant data is time consuming and therefore represents an expensive step in conducting a study.

However, by performing a S-LCA using general data, hotspots can still be identified in a rough analysis and early action/changes can be made. For any S-LCA study, there is a balance between comprehensiveness, usability and reliable results; finding this balance will be crucial especially in the beginning due to increased efforts for conducting the study.

With regard to indicators that need a sufficiently large number of samples, such samples cannot always be based on site specific data. This means that additional data collection activities need to be planned.

Some indicators will be reported with a bias only (child labor, for example, will rarely be reported by an enterprise). This means that the need to validate data (by triangulation and other means) is probably stronger in S-LCA than for other life cycle approaches.

Limitations related to the use of qualitative data, methodologies and indicators

Some of the limitations relate specifically to the nature of social effects. Social effects are not always quantifiable; aggregating them by a common calculation rule may not be straightforward; aggregation of qualitative indicators requires expert judgment. For an aggregation of social effects along a life cycle, little experience exists so far.

Limitations related to the ignorance of causal chains relations

Furthermore, for social effects, causal chains typically exist. These chains occur when one effect or impact, for one stakeholder, causes other social impacts, for the same or for another stakeholder. There may also exist a causal chain to environmental or micro-economic impacts (for example, poor infrastructure may force people to collect firewood, which in turn may result in deforestation).

In S-LCA, these causal chains, either cross-cutting or staying in the social realm, are at present usually disregarded.

Limitations linked to needed skill in practitioner

For the time being, S-LCA practitioners need a strong background both in LCA, CSR and social impacts assessment. Future development of simplified S-LCA tools may facilitate a broader use. However, a certain amount of LCA knowledge and social science background will probably be required to use also the simplified method or at least to interpret the results.

Limitations due to development mode

S-LCA tends to develop indicators in a top down manner that may not represent the views and priorities of the impacted people or their communities. Therefore, it is important to get stakeholders involved and engaged as much as possible in the study process.

The inclusion of stakeholders is a difference in comparison to E-LCA and is an important part of S-LCA, but it may also lead to limitations. There might be a bias in which of the stakeholders can readily be involved in the different stages of S-LCA. Due to restricted resources (time and money), the possibility to involve stakeholders in some of the phases (e.g. the goal and scope phase), may be limited.

Limitations concerning the assessment of the use phase

Assessing the use phase represents a major challenge. The accent in method development so far was placed on production, distribution and end-of-life aspects; therefore, use stage aspects require further development. Thus, with regard to the assessment of the usability and satisfaction of the users, it may be better assessed through other tools or become a future field of research for S-LCA.

Limitations in results communication

A general challenge is that studies of complex systems, which require several assumptions, tend to be hard to communicate in a sufficiently aggregated, but still transparent, manner. This is also a limitation that S-LCA has in common with other systems analysis techniques.

Urgent need for S-LCA

Putting these open issues aside, there is an urgent need for the application of S-LCA. The quest for an assessment of socio-economic effects over the life cycle of a chemical in the European market by the Reach EU directive is a prime example of the need for S-LCA.

6. Presentation and Communication

General

Communication to decision makers and to stakeholders themselves is vital for S-LCA's contribution to improving social performance. The results of the presentation and communication must conform to the specifications within the goal and scope. Based on the goal and scope, the reporting should consider the intended audience. Transparency and objectiveness of reporting mechanisms are fundamental in order to clearly identify decisions made during the study and findings resulting from the study. To ensure transparency, if aggregation is performed, then the detailed findings prior to aggregation need to be kept available in a suitable form.

Requirements for the report

The report should at the very least contain: the objectives of the study; the scope of the study; the system boundaries (through the definition of the commodity chain); the data quality requirements; the involvement of stakeholders; the methodological decisions made (e.g. set of indicators selected, method of data collection); the results of the sLCIA (details regarding the data collection for each of the indicators selected and their impact categories, data analysis, and interpretation of findings).

Subjectivity has been and will always be part of a LCA. This statement is even more applicable to a S-LCA, despite all the attempts to build it on the agreement of different stakeholders. Therefore, reporting seems to be the right place in which this should be made crystal clear.

Data Quality

It is important to address the data quality, as this is fundamental to ensure the reliability and validity of the findings. A possible list of criteria that may be used to assess the data quality would be: collection method; site specific data or industry standard data; completeness – identification of data gaps; accuracy and precision; uncertainty; representativeness of data regarding the population it represents; time period covered; is the data collected at a time when the situation is typical for the region or is the situation atypical. Thus, it is important to maintain a similar level of detail in the presentation of these specifics as when collecting the data. If aggregation was used, it is important to state how it was conducted so that it remains clear to the reader how the findings were obtained.

Summary

In addition, a summary should present not only the major findings of the study but a brief description of the entire study, including the goal and scope definition, the overall system studied, and the expectations as a result of the findings. The summary should, in essence, be a stand-alone section that may be read by any decision-maker in order to obtain an overall understanding of the study and its findings.

Conclusions

The conclusions drawn from the study should be explicit and reflect the processes examined. If additional information is necessary to draw any conclusion, references to the outside sources should be explicitly stated and added to the bibliography, so conclusions remain transparent to the readers.

As an interpretation of the data is necessary to arrive to a conclusion and as the process of interpretation is inherently subjective, the rationales for all conclusions should be explicitly stated. This should allow the reader to understand the method used in arriving at any of the conclusions.

Audience	Possible Form of Report Desired
Policy makers	Full details and summary of report
NGO's	Summary of report where the full report is available on request
Internal Client Studies	Full details
External Client Studies	As defined by client
Public/Media	Synopsis that is approved by practitioner
Consumers	Eco-labels or full public reports or summary of report
Workers	Summary of report relevant to their stakeholder group
Local communities	Summary of report relevant to their stakeholder group

Table 4 – Expected audience and possible forms of reporting desired

7. Review Processes

An independent, critical review can enhance the quality and credibility of an S-LCA, as has been found for E-LCA. Another benefit of critical reviews is to promote learning and development on the part of life cycle practitioners. Thus, it is highly encouraged to plan a critical review process when planning a S-LCA. The ISO standards for LCA state that an independent critical review is required for studies that will be used as the basis of a "comparative assertion," namely a claim about the life cycle superiority of one product over another. The critical review process described in ISO 14044 is an adequate process for S-LCA. With accumulation of further experience in S-LCA, adjustments and refinements to the critical review guidelines that are specific to S-LCA may be developed.

As stated by ISO (ISO 14044, 2006), the critical review process shall ensure that:

- The methods used to carry out the LCA are scientifically and technically valid;
- The data used are appropriate and reasonable in relation to the goal of the study;
- The interpretations reflect the limitations identified and the goal of the study; and
- The report resulting from the study is transparent and consistent.

ISO 14044 also states that "the scope and type of critical review desired shall be defined in the scope phase of a LCA, and the decision on the type of critical review shall be recorded."

Two types of critical review are described by the ISO standards for LCA, as quoted directly (ISO 14044, 2006) below:

1) Critical review being carried by an internal or external expert.
In this case, an independent expert of LCA shall perform the review. The review statement, comments of the practitioner and any response to recommendations made by the reviewer shall be included in the LCA report.

2) Critical review being carried by interested parties.

In such a case, an external independent expert should be selected by the original study commissioner to act as chairperson of a review panel of at least three members. Based on the goal and scope of the study, the chairperson should select other independent qualified reviewers. This panel may include other interested parties affected by the conclusions drawn from the LCA, such as government agencies, non-governmental groups, competitors and affected industries.

For LCIA, the expertise of reviewers in the scientific disciplines relevant to the important impact categories of the study, in addition to other expertise and interest, shall be considered.

The review statement and review panel report, as well as comments of the expert and any responses to recommendations made by the reviewer or by the panel, shall be included in the LCA report.

General criteria for selection of a peer review panel

As noted for environmental LCA and quoted above, ISO recommends that the expertise of reviewers be relevant to the impacts addressed by the study. In this spirit, it is recommended that the expertise of critical reviewers for S-LCAs bring background and experience relevant to assessing social impacts and working with relevant data.

Experience with LCA framework and assessments, with social impact assessment, with social audits, with CSR tools, with the subject matter of the study and a willingness to interact positively could be examples of criteria defined for selecting the reviewers.

8. Future Research and Development Needs

8.1. General Needs

This chapter presents the research and development needs as they are currently identified. Detailing and fine-tuning of the S-LCA methodology will continue, based on experiences gained by practitioners and will lead to additional insights. A distinction is made in the text between general research needs and needs related to the different phases of the methodology.

8.1. General Research Needs

To conduct case studies

Case studies conducted with a S-LCA and additional methodological discussions will help build the knowledge and the practice and as such, represent a research priority. In addition, conducting case studies that include S-LCA, E-LCA and LCC will be beneficial for a greater understanding of the linkages among the methodologies. Eventually, it will build the basis for an integrated approach. In these case studies, potential overlaps must be identified and double-counting avoided.

To produce educational material

The results of conducted case studies will help to illustrate educational material. Educational material will become necessary to effectively communicate the best practices in S-LCA to students and persons willing to undertake S-LCA studies.

To develop tools

In order for S-LCA to become widely used, it is essential to develop and/or complement existing computer models, databases and software tools. The development of those tools will make it easier to conduct a S-LCA and thus democratize the use of the methodology. In addition, the development of a web tool will allow for greater possibilities of bottom-up reporting of social impacts along the life cycle of products.

To document and communicate relationships with other methodologies

There is a need to document and communicate the differences, similarities and complementarities between the enterprise-oriented methodologies, techniques and tools (cf. GRI, ISO 26000 …) and product-oriented methodologies, techniques and tools, as they are developed.

To assess the product utility and social acceptability of products

In relation to the development of a sustainability LCA, the issue of which products can be called sustainable needs to be handled. Thus, the question of the product utility and social acceptability of products needs to be further researched.

To detail the stakeholder approach

A peculiarity of S-LCA is the stakeholder approach. Research groups are currently working with the following categories: worker, consumer, local community, society and value chain actor. Detailing the stakeholder approach and assessing if it should be broadened is a valuable research field to investigate. Future generations is a stakeholder category that has been identified and further reflections are needed to assess whether and how the interests of that category could be taken in account.

Closely linked to the stakeholder "(future) society" is the notion of social responsibility and acceptability of products or services. For example if the social acceptability of SUVs had been considered during the oil crisis in the early 1970s, then maybe such vehicles marketed for urban transportation would never have reached the market. It may be hard to grasp and evaluate at this particular time since there has not been much research in this area yet, but future research in this area may be interesting to consider, especially when seeking to build a tool for sustainable development.

To develop models for the presentation of findings

In order to make the complexity of the results from a S-LCA and possible Sustainability LCA easier to handle, it will be helpful to develop a model for the presentation of findings. In addition, the production of a guidance document on how to present the findings of a study in a reasonable way without losing too much information (e.g. because of result aggregation) will be greatly valuable.

8.2. Definition of goal and scope

To detail the relations between the function and the product utility

In environmental LCA, it is assumed that product utility can be characterized relatively simply and that it is captured sufficiently by the concept of functional equivalence when carrying out comparisons between different products or alternatives. Beside "technical" utility, a range of social aspects such as time requirement, convenience, prestige, etc., are key aspects of product utility. Accordingly, it is essential to describe the functional equivalence (technical utility) and the corresponding social and symbolic functions for the consumer. It is recommended that individuals gain experience using different specifications for the *same* good or service, while taking into account diverse descriptions, in order to look at the different outcomes.

To develop S-LCA consequential methodology

Further thinking leading to further development of consequential S-LCA (which can address the consequences of certain changes in a prospective manner) is needed. This topic will also benefit from case studies experiences and from collaboration with the ongoing development and application of consequential E-LCA.

8.3. Inventory Analysis Needs

To document system boundary practices in S-LCA and identify the process that is socially significant

Further research and case studies will help to better assess which processes are the most socially significant, and which are less socially significant and may therefore be cut-off. This may lead to the inclusion of different processes within the studied system as compared to an E-LCA of the same product. It is highly suggested that S-LCA practitioners report about their system boundary practices so guidelines may be developed.

To develop further the methodological sheets of subcategories

Methodological sheets of subcategories include all the necessary information to collect data on a topic. They are very valuable to exchange views on social criteria and subcategories definitions and most valuable at the data collection phase of the study. Therefore, their development and improvement should represent a research priority.

8.4. Data Needs

There is a fundamental need to develop databases.

Data represent the determining aspect of S-LCA development and application. Development of databases that would help screening for hotspots is key and highly needed. Priorities include the development of databases with information in the right format and with relevant metadata.

8.5. Impact Assessment Needs

Impact assessment methodologies are under development and are an *open* field for future research. Cause and effect relationships for social and socio-economic aspects need to be further investigated. In addition, discussions on areas of protection need to take place (e.g. in both environmental impact assessment and when evaluating social and socio-economic impacts, situations occur where cause-effect chains are less well-known or even unknown). Moreover, looking at possible trade-offs between the areas of protection in a S-LCA, an E-LCA and LCC could benefit from further research. In fact, this is very much related to the distribution of impacts: how should results be interpreted (and how should impacts be assessed) to enable one to present a reasonable outlook? For example, the negative social impacts on stakeholders which are already in a bad position, versus the negative impacts of the same kind on stakeholders that are better off.

The elaboration of inventory indicators to assess the various social issues of concern (subcategories) is a crucial work for the S-LCA method. Characterization models, as well as scoring and weighting systems, need to be defined following the more up to date knowledge from the social sciences and the relevant international agreements (e.g., ILO for the stakeholder Employees). See section 4.4.5 for more details on the elaboration of S-LCA indicators.

Further developments of impact assessment methods, socio and socio-economic mechanisms and scoring systems are greatly needed. In particular, development of a “meaning” database, which would include the necessary data for interpretation (e.g. minimum wage and livable wage by country) would represent a major advancement for S-LCA practice.

8.6. Review process

As S-LCA becomes increasingly used, further guidance for review will become essential to structure the practice and ensure quality of the studies.

9. Conclusion

The Project Group on a S-LCA, under the umbrella of the UNEP/SETAC Life Cycle Initiative, started its work five years ago. There were multiple aims, but the most important one was *"to convert the current environmental tool LCA into a triple-bottom-line sustainable development tool."*[54] In the same period, other groups within (eg. LCC) and outside (eg. GRI, ISO 26000) this initiative proceeded in their methodological work and influenced the discussions. The result is a set of "Guidelines for complementing E-LCA and LCC, and by doing so contributing to the full assessment of goods and services within the context of sustainable development" (Guidelines for Social Life Cycle Assessment of Products), taking into account *"… predominantly the impact categories … chosen in accordance with internationally recognised categorisations/ standards … and/or in a multistakeholder process."* (Griesshammer R. et al., 2006).

Chapters 1 and 2 describe the (historical) elements of context in which the Guidelines should be placed. From the broad and vague concepts of sustainable development and human wellbeing to the more specific goal of sustainable consumption and production (including corporate social responsibility) a link is made with life cycle thinking and related techniques and tools for assessment. Before going into details in the methodology of a S-LCA (a social and socio-economic LCA), Chapter 3 explains clearly the principles of an E-LCA and a LCC, including a comparison with a S-LCA. This important chapter clearly shows the differences and the communalities.

Chapter 4 provides an adequate technical framework for a S-LCA from which a larger group of stakeholders can engage to move towards a sustainability LCA when assessing goods and services. It draws largely and whenever possible on the E-LCA methodology. In this chapter the four major phases (goal and scope of the study, inventory analysis, impact assessment, and interpretation) of the methodology are presented and detailed in a systematic and coherent manner. Figures and practical examples clarify the methodology. Of equal importance is the recommendation that the list of subcategories is set as a minimum of issues to be assessed during a S-LCA. This aims to prevent the use of S-LCA results on a few limited topics for social marketing purposes while not addressing core issues.

Although the Technical Framework for a S-LCA gives the current status for which there is a consensus at the international level, it is clear that there are still some methodological problems to be resolved. Chapter 5 lists the possible applications and the limitations. As for every other assessment which is communicated to decision makers and to stakeholders, respecting transparency and objectiveness of reporting mechanisms is fundamental in order to clarify choices made and findings resulting from the study. Openness to a review process might help in this task. Chapter 6 and 7 outline the approach to be taken.

At last, Chapter 8 presents the research and development needs as they are currently identified. Detailing and fine-tuning of the S-LCA methodology will continue, based on experience gained by practitioners, and will lead to additional insights.

From now on the international community can apply the methodology for a S-LCA as outlined in these Guidelines. The authors are looking forward to interacting during the coming years with colleagues and stakeholders on the results obtained in case studies, including on recommendations for methodological improvement.

54 See **http://lcinitiative.unep.fr.**

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www.un.org/millenniumgoals/index.shtml

Millennium Ecosystem Assessment
www.millenniumassessment.org

OECD guidelines for multinational enterprises
www.oecd.org/daf/investment/guidelines

SA 8000
www.sa8000.org

SiRi
www.siricompany.com/background.shtml

UNEP- DITE- Life Cycle and Resource Management
http://www.unep.fr/scp/lifecycle/

UNEP/UN Global Compact Environmental Principles Training package (2005) can be downloaded from
www.unep.fr/shared/publications/other/DTIx0601xPA/

UNEP/SETAC Life Cycle Initiative
lcinitiative.unep.fr/

UN Global Compact
www.unglobalcompact.org

United States Department of Agriculture
www.usda.gov

Universal Declaration of Human Rights (1948)
www.un.org/Overview/rights.html

World Bank
www.worldbank.org

World Business Council for Sustainable Development (WBCSD)
www.wbcsd.org/

World Economic Outlook Reports (IMF)
http://www.imf.org/external/ns/cs.aspx?id=29

Annex 1a – List of meeting, workshops and seminars organized by the Project Group on a S-LCA

1st Meeting (April 2004, Prague)

Workshop (November 2004, Ghent)

2nd Meeting (January 2005, Bologna)

3rd Meeting (May 2005, Lille)

Seminar (November 2005, Brussels)

4th Meeting (June 2006, Lausanne)

5th Meeting (October 2006, Paris)

6th Meeting (March 2007, Sevilla)

7th Meeting (August 2007, Zurich)

8th Meeting (October 2007, Montréal)

Seminar (October 2005, Montréal)

9th Meeting (February 2008, Paris)

10th Meeting (June 2008, Freiburg)

11th Meeting (September 2008, Vienna)

12th Meeting (January 2009, Paris)

Annex 1b – List of stakeholders involved through interaction

Accountability International (AI)

Consumers International (CI)

Fair Labor Association (FLA)

Fair Trade Advocacy Office (FTAO)

International Consumer Research & Testing Ltd (ICRT)

International Labour Office (ILO)

International Organization of Employers (IOE)

International Social and Environmental Accreditation and Labelling Alliance (ISEAL)

International Trade Union Confederation (ITUC)

United Nations Environment Programme (UNEP)

US International Bureau of Labor Affairs (ILAB)

World Business Council for Sustainable Development (WBCSD)

Annex 2 – Illustrations of Conceptual systems

Five illustrations can help clarify the fact that different practitioners and studies can adopt different conceptions of a system: Consequential versus attributional models; the inclusion of infrastructure or not; the inclusion of service inputs or not, the inclusion of business overhead inputs or not, and finally, in the case of consequential modeling, the inclusion of non-physical causal influences.

First example: Attributional versus consequential.[55]
Attributional models model the impacts associated with "how things are made." Regarding E-LCA, Heijungs (1997) has said that they assign or attribute some of the total pollution occurring in the world, to the life cycles of individual products. In this sense they can be seen as "assigning blame." This was the first conceptual approach to defining, and is still a predominant basis for conceptualizing a product life cycle.

These systems tend to be constructed by asking, for each unit process, "what direct natural resources and what purchased materials and energy are used in this process,", and then tracing the links for all purchased inputs to ask the same question of their production, and so on.

For attributional modeling, the "reference flows" are the final inputs of products and energy, including the product itself, required to enable the product to deliver its function. The first tier of unit processes in the potential system upstream of a product's usage phase will then be all those which produce the reference flows and transport them to the point of use or handle the disposal of the product after use. The second tier of unit processes in the potential system is those unit processes that manufacture and transport all inputs of materials and energy to each of the tier-1 processes. The third tier produces and transports all inputs to tier-2, and so on. There is, in principle, no *a priori* upstream end or cut-off to these supply chains in an attributional model.

Consequential models, instead of being a conception or model of "how things are made," are rather constructed in an attempt to estimate the impacts of consequences of decisions, such as the decision to purchase Product A instead of Product B. There is only partial overlap between the contents of consequential and attributional models. This is primarily because not all flows included in an attributional model of "how Product A is made" are expected to change when more or less of Product A is produced. If a flow seems to be used to make product A but the quantity of this flow does not change when more or less of Product A is made, it would be included in an attributional model but excluded from a consequential model. For example, an attributional model of electricity production reflects the full fuel mix for the region of study, including baseload plants that produce at maximum output throughout the year regardless of demand. Baseload plants include hydro and nuclear – even when their output is not determined by demand for electricity. A consequential model of electricity supply will include only those types of plants whose outputs are expected to be impacted by changes in demand. Note that short-term demand impacts are levels of output from existing plants, while long-term demand impacts include timing of retirement of old plants and construction of new plants.

Another example where consequential and attributional models differ relates to cases where the supply of a flow is constrained, as can be the case for recycled materials. If post consumer recovery rates are already at their maximum practical level or are not responsive to the demand for the post-consumer material, then consequential and attributional models of products produced using post-consumer material will differ. The attributional model will be conceptualized based on the idea that "Product A is made with post-consumer material, not virgin material," and will model accordingly. The consequential model is conceptualized with a different question, and takes a different form as a result. The question: when more or less of Product A is made, what happens to the flows of materials, products, resources, energy and pollution? If supply of post-consumer material is constrained, then increased production of Product A (made with recycled material) may mean that another product, which *would have been made* with recycled material will now be made with virgin material instead. If increased demand for Product A increases the production of virgin material then this is what a consequential model will attempt to model.

55 Key references on consequential modeling and its influence on system scope include Wenzel (1998) and Ekvall and Weidema (2004).

It should be noted in S-LCA that even if a change in demand does not affect (increase/decrease) the production of Product A there may be a change in, for example, enterprise management due to changes in prices, which can lead to social and economic consequences, thus suggesting the inclusion of Product A in the consequential model in S-LCA.

Second example: Whether or not to include inputs of infrastructure?

Inputs of infrastructure include such things as the construction and maintenance of the factory in which a product is manufactured, the construction and maintenance of the road and vehicle required for truck transportation, construction and operation of the port as well as ship required for ocean freight, etc. Infrastructure can be defined as inputs to a process that does not constitute part of the product output and which is not used up within one year as an ancillary input to the production.

Inputs of infrastructure were tacitly excluded by most LCAs into the 1980s. At that time, some analysts began to question this exclusion, and tested whether infrastructure inputs could be environmentally significant. Some cases (including transportation), have shown that infrastructure burdens are non-trivial, others demonstrated the potential importance. In fact, it is rather a question of motivating the cut-off-criteria. Indeed, the answer to the question, "What is in and what is out?" should be in line with the goal and scope of the study. Either way, according to the ISO standard, all relevant parts of the life cycle have to be included in the study.

Third example: Whether or not to include inputs of services?

Inputs of services include such things as legal services, advertising, engineering and architectural design, and so on. These are typically not included in process-based LCA databases, but they are included in economic input/output models, and therefore in IO-LCA databases. They have been found to be environmentally quite significant, for example as inputs to construction, and may be significant also concerning social impacts since services may be worker intensive activities.

Fourth example: Whether or not to include other *business overhead* inputs?

Employee commuting to the work site has been shown to be very important, especially for service sectors. Business travel can also be important.

Another category of overhead is the energy (and materials) used for maintenance, lighting, and climate-condition a facility, and those used to maintain the grounds outside the structure as well. These inputs – especially for lighting and heating/ventilation/air conditioning - can be of the same order of magnitude as the direct energy inputs to manufacturing processes, even at a heavy manufacturing facility. But routine practice by many LCA practitioners (and databases) has been to exclude this category of input for many or all unit processes.

Fifth example: Including Non-Physical (or Informational) Causal Connections

As described by neoclassical economics, inputs to production (called "factors of production") can be scarce and in some cases their output at least in a local context be fully constrained. This is the case in our earlier example of post-consumer recycled material, which is at full practical recovery level and fully utilized. In the economic world-view, a central phenomenon is the role of price in mediating supply and demand. When demand for a scarce resource increases, this increases the price, which leads to additional production (if production is not constrained, but rather is able to respond to price, which economists term "elastic"). Once the mechanisms of supply constraints and price responses are understood, real-world instances of these mechanisms become impossible for practitioners to ignore when conceptualizing models.

A recent article on consequential life cycle inventory modeling of land use makes the point nicely (Kloverpris et al., 2008). The authors first note that in attributional inventory models:

> inventory data from the *direct crop suppliers* (farmers producing the crops used in the relevant life cycle) is often used. However, this does not necessarily reflect the actual consequences of crop consumption in markets involving international trade ... if production cannot be increased in the country or region in question, production will be increased elsewhere. The question is where and how. The location in which crop production is increased and the ways in which it is increased (intensification or crop land expansion) are decisive for the environmental impacts of crop consumption.

People exposed to work on technology innovation and feedback loops will be on the lookout for cases where increased demand for a "young" technology leads to technological learning, which reduces costs of production, lowers price, and further increases demand, which promotes further technological learning and further price reductions and further expansion in market share. This phenomenon is active in the markets for renewable energy, for example. It can mean that the full consequences of a decision to purchase a young technology in lieu of a conventional one are significantly underestimated by a static model that is blind to these feedback loops.

As one more example, people sensitized to social impacts outside of market models of production will be on the lookout for causal links to impacts that are missed by engineering models and market models. For example, increased production of "sustainable" bamboo flooring in China increases local demand for bamboo, a traditional (and traditionally abundant) material for local construction of housing and furniture. Local production to serve external markets changes a local resource from abundant to scarce, introducing competition and price, and potentially having major impacts on the poverty of people in the communities near the production facility (Norris G., 2007).

Annex 3 – Glossary

Term	Explanation/Definition
Activity variable	An activity variable is a measure of process activity or scale which can be related to process output. Activity variables, scaled by the output of each relevant process, are used to reflect the share of a given activity associated with each unit process. Thus, for attributes concerning labor conditions, a relevant activity variable is worker-hours. Process-specific coefficients of worker-hours per unit of process output are used to estimate the share of total life cycle worker-hours associated with each unit process.
Aggregation	The action of summing or bringing together information (e.g. data, indicator results, etc.) from smaller units into a larger unit. (e.g., from inventory indicator to subcategory). In S-LCA, aggregation of data may be done at the life cycle inventory or impact assessment phase of the study and should not be done in a way that leads to loss of information about the location of the unit processes.
Area of protection [The term "Damage category" can be used as a synonym]	A cluster of category endpoints of recognizable value to society e.g., human health, natural resources, natural environment and man-made environment. Joroen B. (2002)
Attributes [see "Life Cycle Attribute Assessment"]	Properties or characteristics of a process, which are of interest to stakeholders.
Subcategory	A representation/constituent of an impact category. e.g., child labor or human rights.
Characterization	In sLCIA, the characterization models are the formalized, and - not always - "mathematical" operationalization of the social and socio-economic Mechanisms. They may be a basic aggregation step, bringing text or qualitative inventory information together into a single summary, or summing quantitative social and economic inventory data within a category. Characterization models may also be more complex, involving the use of additional information such as performance reference points.
Characterization factor	Factor derived from a characterization model which is applied to convert an assigned life cycle inventory analysis result to the common unit of the category and/or subcategory indicator. ISO 14040 (2006)
Classification	The classification step is the step where the Inventory results are assigned to a specific Stakeholder Category and/or Impact Category.
Cut-off criteria	Specification of the amount of material or energy flow or the level of significance associated with unit processes or product system to be excluded from a study. Adapted from ISO 14040 (2006)
Developing economies	Developing and emerging economies include all countries that are not classified as advanced economies. IMF provides a classification that is revised each year in its World Economic Outlook.
E-LCA	Environmental Life Cycle Assessment (E-LCA), is an assessment technique that aims at addressing the environmental aspects and their potential environmental impacts throughout a product's life cycle.
eLCC	An assessment of all costs associated with the life cycle of a product that are directly covered by any one or more of the actors in the product life cycle (e.g., supplier, manufacturer, user or consumer, or EoL actor) with complementary inclusion of externalities that are anticipated to be internalized in the decision-relevant future. Hunkeler et al. (2008)
Elementary flow	Material or energy entering the system being studied that has been drawn from the environment without previous human transformation, or material or energy leaving the system being studied that is released into the environment without subsequent human transformation. ISO 14040 (2006)
Environmental aspect	Element of an organization's activities, products or services that can interact with the environment. ISO 14040 (2006)

Term	Explanation/Definition
Focus group	A focus group is a type of group interview organized to acquire a portrait of combined local perspective on a specific set of issues. What distinguishes the focus group technique from the wider range of group interviews is the explicit use of the group interaction to produce data and insights that would be less accessible without the interaction found in a group.
Functional unit	Quantified performance of a product system for use as a reference unit in a life cycle assessment study. ISO 14040 (2006)
Generic data	Data that is not site or enterprise specific.
Goal and scope	The first phase of an LCA; establishing the aim of the intended study, the functional unit, the reference flow, the product system(s) under study and the breadth and depth of the study in relation to this aim. Joroen B. (2002)
Ideal system	System accurately reflecting the complex network of relations and interrelations present in real life systems. NOTE: The system model (as a model always is) is a simplified system, deliberately disregarding some of the interrelations in order to arrive at a complete system suitable for an assessment.
Impact category	Impact Categories are logical groupings of S-LCA results, related to social issues of interest to stakeholders and decision makers.
Input	Product, material or energy flow that enters a unit process. ISO 14040 (2006)
Inventory indicator	Inventory indicators provide the most direct evidence of the condition or result they are measuring. They are specific definitions of the data sought. Inventory indicators have characteristics such as type (eg. qualitative or quantitative) and unit of measurement.
Life cycle attribute assessment [See “attribute”]	A method that enables to express the percentage of a supply chain that possesses (or lacks) an attribute of interest. Norris (2006)
Life Cycle Costing	Life cycle costing, or LCC, is a compilation and assessment of all costs related to a product, over its entire life cycle, from production to use, maintenance and disposal.
Life cycle inventory	Phase of a S-LCA where data are collected, the systems are modeled, and the LCI results are obtained.
LCIA	Phase of a S-LCA that aimed at understanding and evaluating the magnitude and significance of the potential impacts for a product system throughout the life cycle of the product. Adapted from ISO 14040 (2006)
Life Cycle Thinking	Going beyond the traditional focus on production site and manufacturing processes so to include the environmental, social, and economic impact of a product over its entire life cycle. The main goals of life cycle thinking are to reduce a product’s resource use and emissions to the environment as well as improve its socio-economic performance throughout its life cycle. UNEP-DTIE-Life Cycle Management, a Business Guide to Sustainability
Environmental mechanism	System of physical, chemical and biological processes for a given impact category, linking the life cycle inventory analysis results to category indicators and to category endpoints
Method	Specific procedure within a technique.
Methodology	Coherent set of methods.
Organization	Company, corporation, firm, enterprise, authority or institution, or part or combination thereof, whether incorporated or not, public or private, that has its own functions and administration. ISO 14001 (2004)
Output	Product, material or energy flow that leaves a unit process. ISO 14040 (2006)
Performance Reference points	Additional information used in characterization models. Performance reference points may be internationally set thresholds, goals or objectives according to conventions and best practices, etc.
Pressure	Powerful influence
Primary data	Information that researchers gather first hand.
Product	Any goods or service offered to members of the public either by sales or otherwise. ISO 26000 –WD4.2 (2008)

Term	Explanation/Definition
Product-oriented assessment/ enterprise-oriented assessment	Product-oriented assessments are the assessments which focus on the total effects caused by the production and consumption of a product. Organizational aspects/ impacts/ attributes pertaining to the different organizations of the supply chains may be included as part of a product assessment Organization-oriented assessments are the assessments which focus on the effects of an organization actions. It may include indirect effects resulting from the relationship with or the behavior towards different stakeholder groups. It does not include upstream impacts from products purchased nor downstream impacts of products sold.
Qualitative indicators	Qualitative indicators are nominative: they provide information on a particular issue using words. For instance text describing the measures taken by an enterprise to manage stress.
Quantitative indicator	A quantitative indicator is a description of the issue assessed using numbers: for example number of accidents by unit process.
Reference flow	A reference flow is a quantified amount of product(s), including product parts, necessary for a specific product system to deliver the performance described by the functional unit.
Scope of the study	The scope is defined in the first phase of the study. It encompasses issues of depth and breadth of the study. It defines the limits placed on the product life-cycle (that can be infinite) and on the detail of information to be collected and analyzed. It defines where the data will be coming from, how up-to-date the study will be, how information will be handled, and where the results will be applicable.
Scoring system	Scoring may use quantitative or qualitative scales, according to the availability of information and the subcategory or impact category under consideration. Scoring systems usually seek to standardize the scores for purpose of comparison. Adapted from Sven-Olof Ryding ed. (1993)
Semi-quantitative indicator	Semi-quantitative indicators are indicators that have results expressed into a yes/ no form or a scale (scoring system): for example, presence of a stress management programme (yes-no). Qualitative and quantitative indicator results may be translated into a semi-quantitative form.
Secondary data	Data gathered by other researchers or collected for other purpose than the one being currently considered or, often a mix of the two.
Sensitivity analysis	Systematic procedures for estimating the effects of the choices made regarding methods and data on the outcome of a study
Social Impact Assessment (SIA)	Social Impact Assessment (SIA) is the process of identifying the social consequences or impacts that are likely to follow specific policy actions or project development, to assess the significance of these impacts and to identify measures that may help to avoid or minimize adverse effects.
Significant issues in S-LCA	Significant issues are the important social findings and the critical methodological choices. They include the identification of key concerns, limitations and assumptions made during the study and resulting from the study.
S-LCA	A social and socio-economic Life Cycle Assessment (S-LCA) is a social impact (real and potential impacts) assessment technique that aims to assess the social and socio-economic aspects of products and their positive and negative impacts along their life cycle encompassing extraction and processing of raw materials; manufacturing; distribution; use; re-use; maintenance; recycling; and final disposal.
Social capital	The social conditions, such as institutions, rule of law, trust, and human networks, that are prerequisites or catalysts for production, but do not enter into the production themselves.
Social endpoints	A social attribute or aspect identifying an issue giving cause for concern (e.g., well-being of stakeholders). Adapted from ISO 14040 (2006)
Social hotspots [The term “Bottleneck” can be used as a synonym for negative hotspots]	Social hotspots are unit processes located in a region where a situation occurs that may be considered as a problem, a risk or an opportunity, in function of a social theme of interest. The social theme of interest represents issues that are considered to be threatening social well-being or that may contribute to its further development.

Term	Explanation/Definition
Social impacts	Social impacts are consequences of positive or negative pressures on social endpoints (i.e. well-being of stakeholders).
Social impact pathway [The term "Social mechanism" can be used as a synonym]	An impact pathway that involves social LCI results and/or social impact categories.
Social indicators	Social indicators are evidence, subjective or objective, qualitative, quantitative or semi-quantitative being collected in order to facilitate concise, comprehensive and balanced judgements about the condition of specific social aspects with respect to a set of values and goals. In LCA social indicators are indicators of a social LCI result (pressure) or of a social impact category.
Social significance	Social significance is a judgment on the degree to which a situation or impacts are important. It is highly dependent on context, based on criteria, normative, contingent on values and entails considering trade-offs.
Socio-economic	Which involves a combination of social and economic factors or conditions.
Stakeholder	Individual or group that has an interest in any activities or decisions of an organization. (ISO/CD 26000 -2008-)
Stakeholder category	Cluster of stakeholders that are expected to have similar interests due to their similar relationship to the investigated product systems
Stakeholder theory	Theory that identifies and models the groups which are stakeholders of a corporation, and both describes and recommends methods by which management can give due regard to the interests of those groups. Freeman *et al.* (2004)
Supply chain	A supply chain, or logistics network, is the system of organizations, people, technology, activities, information and resources involved in moving a product or service from supplier to customer. Supply chain activities transform natural resources, raw materials and components into a finished product that is delivered to the end customer. In sophisticated supply chain systems used products may re-enter the supply chain at any point where residual value is recyclable. Supply chains link value chains. Nagurney (2006)
System scope	System scope = system boundary: set of criteria specifying which unit processes are part of a product system. ISO 14040 (2006)
Technique	Systematic set of procedures to perform a task.
Themes	Social themes of interest represent issues that are considered as threatening social well-being or that may contribute to its further development. Social themes of interest include but are not restricted to: human rights, work conditions, cultural heritage, poverty, disease, political conflict, indigenous rights, etc.
Tool	Instrument used to perform a procedure
Triangulation	Triangulation implies that different perspectives are brought together when investigating an object or research question. These perspectives can consist in different methods that are applied, in different theoretical approaches that are followed or more frequently in a combination of different types of data or data collection methods. It also refers to the collection of data from different persons or stakeholders or stakeholder groups which are contrasted.
Uncertainty	Uncertainty refers to the lack of certainty e.g., in the prediction of a certain outcome, in a measurement, or in an assessment results. It is a general term used to cover any distribution of data caused by either random variation or bias. In LCA, evaluation or measurement of uncertainty is an on-going process and relates to all the elements of data quality as well the aggregation model used and to the general aims of the study as set in the goal and scope.
Unit process	Smallest portion of a product system for which data are collected when performing a life cycle assessment. ISO14040 (1997)
Weighting	Converting and possibly aggregating indicator results across impact categories using numerical factors based on value-choices; data prior to weighting should remain available. ISO 14040 (2006)
WE-LCA	Working environmental LCA is a compilation and evaluation of the inputs, outputs and potential working environmental impacts on humans of a product system throughout its life cycle. (Poulsen and Jensen, 2004)

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About SETAC

The Society of Environmental Toxicology and Chemistry (SETAC) is a professional society in the form of a non-forprofit association, established to promote the use of a multidisciplinary approach to solving problems of the impact of chemicals and technology on the environment. Environmental problems often require a combination of expertise from chemistry, toxicology, and a range of other disciplines to develop effective solutions. SETAC provides a neutral meeting ground for scientists working in universities, governments, and industry who meet, as private persons not bound to defend positions, but simply to use the best science available.

Among other things, SETAC has taken a leading role in the development of Life Cycle Management (LCM) and Life Cycle Assessment (LCA).

The organization is often quoted as a reference on LCA matters.

For more information, see **www.setac.org**

About the UNEP Division of Technology, Industry and Economics

The UNEP Division of Technology, Industry and Economics (DTIE) helps governments, local authorities and decision-makers in business and industry to develop and implement policies and practices focusing on sustainable development.

The Division works to promote:

> sustainable consumption and production,
> the efficient use of renewable energy,
> adequate management of chemicals,
> the integration of environmental costs in development policies.

The Office of the Director, located in Paris, coordinates activities through:

- **The International Environmental Technology Centre** - IETC (Osaka, Shiga), which implements integrated waste, water and disaster management programmes, focusing in particular on Asia.
- **Sustainable Consumption and Production** (Paris), which promotes sustainable consumption and production patterns as a contribution to human development through global markets.
- **Chemicals** (Geneva), which catalyzes global actions to bring about the sound management of chemicals and the improvement of chemical safety worldwide.
- **Energy** (Paris), which fosters energy and transport policies for sustainable development and encourages investment in renewable energy and energy efficiency.
- **OzonAction** (Paris), which supports the phase-out of ozone depleting substances in developing countries and countries with economies in transition to ensure implementation of the Montreal Protocol.
- **Economics and Trade** (Geneva), which helps countries to integrate environmental considerations into economic and trade policies, and works with the finance sector to incorporate sustainable development policies.
- **Urban Environment** (Nairobi), which supports the integration of the urban dimension, with a focus on environmental issues that have both a local and an international dimension.

UNEP DTIE activities focus on raising awareness, improving the transfer of knowledge and information, fostering technological cooperation and partnerships, and implementing international conventions and agreements.

For more information, see **www.unep.fr**

Behind the life cycle of a product, from the cradle to the grave, there is a story to tell.

Not only about its potential impact on the environment, but as well in terms of social and socio-economic impacts - or potential impacts - of its production and consumption on the workers, the local communities, the consumers, the society and all value chain actors. Today's value chains are often complex, global and because of it, faceless. Shedding light on the human relationships impacted by the life cycle of goods and services helps to re – establish the connection and identify ways in which social conditions can be improved.

Therefore, there is a need for guidelines to complement Environmental Life Cycle Assessment (E-LCA) and Life Cycle Costing (LCC), and by doing so contributing to the full assessment of goods and services within the context of sustainable development.

These Guidelines present the Social and socio-economic Life Cycle Assessment (S-LCA), a powerful technique to assess and report about these impacts and benefits of product life cycle from the extraction of the natural resources to the final disposal. It provides an adequate technical framework from which a larger group of stakeholders can engage to move towards social responsibility when assessing the life cycle of goods and services.

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