



Social Life-Cycle Assessment and Social Impact Audit Tool

– A White Paper

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“Four years have elapsed since leaders committed to achieving the Sustainable Development Goals (SDGs) in their countries by 2030. Eleven years remain. Sustainable development will falter without data. We must put national data systems in place, or the SDGs will be little more than feel-good aspirations” (Espey J. 2019¹)

Abstract

The last 20 years have seen growing pressure to introduce Sustainability into STEM curricula, including materials education, for undergraduates. Engaging students with this blend of engineering, economics and social science is challenging.

GRANTA’s CES EduPack already offers an easy-to-use Eco Audit Tool that allows students to explore the environmental impact of a product throughout its lifecycle. It also contains cost models that expose some of the economic aspects.

This White Paper introduces a new Social Impact Audit Tool designed to introduce students to the Social Life-Cycle Assessment (S-LCA) of products. It is based on the widely accepted UNEP/SETAC “Guidelines for Social Life Cycle Assessment of Products” (2009)², allowing students to explore scenarios that illustrate the S-LCA, its recommended Protocol.

The Tool is implemented in Excel. The motive is educational: to introduce the concept of social life-cycle assessment of products to students of Materials Science, Engineering and Design in a simple way and to provide the tools and data to allow them to apply it.

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¹ Espey J. (2019), “Sustainable development will falter without data”, Nature, 571, 299, doi: 10.1038/d41586-019-02139-w.

² The Guidelines are currently being reviewed by a team of researchers at the “lifecyclinitiative.org” and a feedback being sought before its new release in June 2021.

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1. Sustainability and the three capitals

Sustainable manufacturing has three fundamental components. They are commonly represented by three overlapping circles, known as the “Triple bottom line” or the “3-Ps”, as in Figure 1 on the left. It’s a catchy icon but one that doesn’t take us very far. It is more helpful, instead, to think of three *capitals* (shown center and right in Figure 1). A capital is an asset that can be built up, conserved by appropriate husbandry or drawn down and exchanged for other goods and services. The resources of the earth’s crust and oceans can be thought of as *Natural Capital*, an asset inherited from the planet’s geological and biological history. The accumulated infrastructure and wealth of a nation constitute its *Manufactured and Financial Capital*, assets built up by investment and added value. Finally, the cultural and intellectual resources of a nation and the ability of its people to contribute to human welfare, development and happiness can be thought of as *Human and Social capital*.

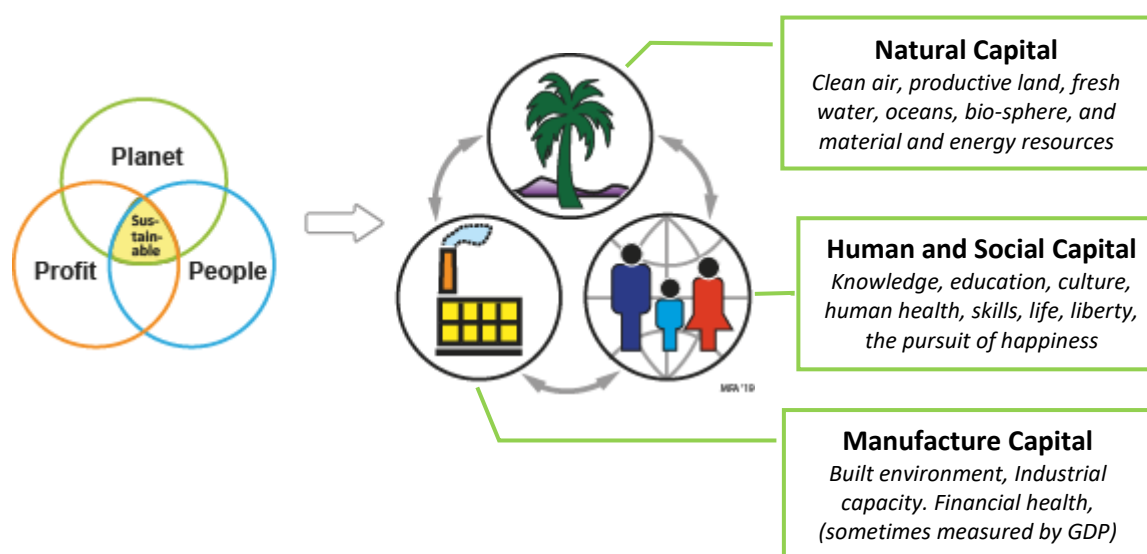


Figure 1. The “3-Ps” and their reinterpretation as three “Capitals”

The three capitals are not independent. Natural capital provides the materials and (at present) most of the energy that supports manufacturing and generates financial capital. These, in turn, provide the resources that support education, health care and social support that are the building blocks of human and social capital. And it is the understanding and ability to reason engendered by human capital that provides the motivation methods to conserve natural capital.

The three capitals are not always treated with equal respect. Often economic considerations eclipse the environmental and social priorities. Standard methods for Environmental Life-Cycle Assessment (E-LCA)³ and Economic Life-cycle Costing (LCC)⁴ of products have existed and been practiced for the last 30 years. Social Life-Cycle Assessment (S-LCA) is much younger. The formulation of an assessment Protocol for S-LCA first appeared in 2009 with the publication of the UNEP-SETAC “Guidelines for Social Life Cycle Assessment of Products”⁵ (UNEP/SETAC Report). Ways of implementing the protocol are currently under development. Figure 2 summarizes the current position.

³ ISO 14004 - 14044 (1990 – 2006) “Environmental management – Lifecycle assessment – Requirements and Guidelines” International Organization of Standards”

⁴ IISD (International Institute for Sustainable Development “Life Cycle Costing”, <http://ec.europa.eu/environment/gpp/pdf/WP-LifeCycleCosting.qx.pdf>

⁵ UNEP-SETAC (United Nations Environmental Program) (2009) “Guidelines for Social Life Cycle Assessment of Products”, http://www.unep.fr/shared/publications/pdf/dtix1164xpa-guidelines_slca.pdf

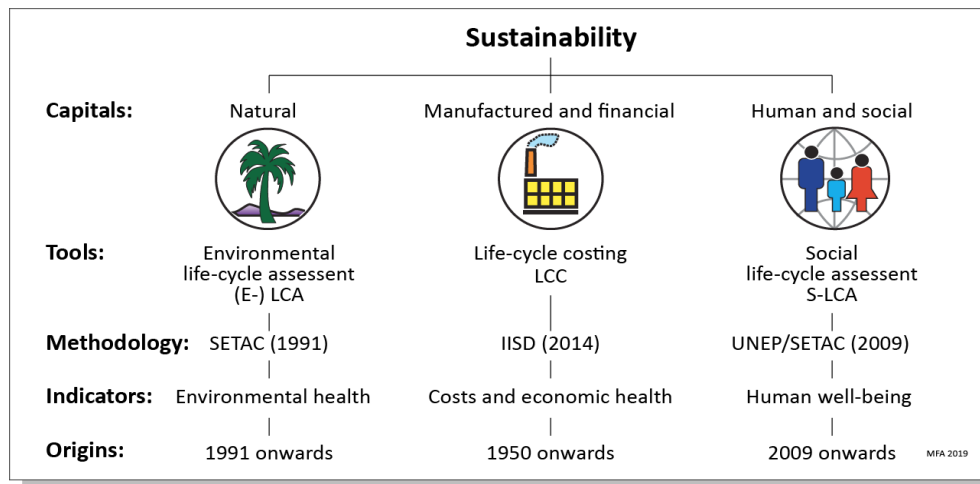


Figure 2. Life cycle assessment (LCA), life cycle costing (LCC) and social life-cycle assessment (S-LCA)

The ultimate goal of a S-LCA is to improve social conditions and socio-economic performance associated with a product throughout its life. The Assessment identifies Social Hotspots: point of contact between stakeholders and aspects of the materials, manufacture, distribution and use of the product that may, potentially, be damaging or could be influenced in a positive way.

S-LCA and the UN Sustainable Development Goals. The approach developed in the UNEP Guidelines meshes well with the 2030 Agenda for Sustainable Development, adopted by all United Nations Member States in 2015⁶. It defines 17 Sustainable Development Goals (SDGs) (Figure 3), that include ending poverty and other deprivations, improving health and education, stimulating economic growth and tackling climate change and working to preserve our oceans and forests. Figure 3⁷ illustrates how the SDGs align with the three main pillars of sustainability, where economies and societies are embedded within the biosphere. It highlights the fundamental position of the biosphere (Folke et al, 2016).



Figure 3. The UN Sustainable Development Goals and their alignment with the Three Capitals (Folke et al, 2016).

⁶ The UN Sustainable Development Goals, [www.https://sustainabledevelopment.un.org/?menu=1300](https://sustainabledevelopment.un.org/?menu=1300)

⁷ Folke, C., R. Biggs, A. V. Norström, B. Reyers, and J. Rockström (2016), "Social-ecological resilience and biosphere-based sustainability Science", Ecology and Society 21(3):41, <http://dx.doi.org/10.5751/ES-08748-210341>

2. Social life-cycle assessment, S-LCA

Products provide practical utility: shelter, transport, protection and comfort, for example. They also carry social utility: prestige, status, convenience, cultural associations and reassurance. But product development processes can also be environmentally and economically damaging and can harm human well-being through unfair practices, poor working conditions and failure to respect human rights. How can we design products, which are durable, safe, environmentally friendly and with an increased or retained value at the end of their lives?

Environmental life-cycle assessment (E-LCA) explores the eco-impact of product manufacture, use and disposal. Social life-cycle assessment (S-LCA), by contrast, is more about the behaviour of the enterprises making the product and the social and political norms of the nations in which these take place. S-LCA draws on the same underlying methodology of E-LCA, with a focus now on the impact of product life on the well-being of the stakeholders.

The steps laid out in the UNEP/SETC Guidelines for S-LCA (discussed earlier and pictured here) take a form that parallels that of E-LCA:

- Establish goal and scope:
Functional unit, Stakeholders and Impact categories
- Social Life-Cycle inventory
- Social Life-Cycle impact assessment
- Interpretation and options for action
- Examine the wider implications

They are explained more fully in the following paragraphs.

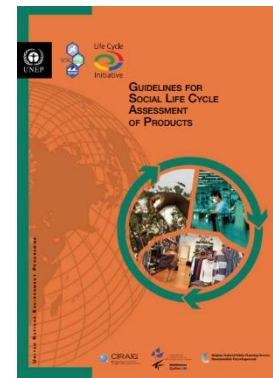


Figure 4. The UNEP/SETC Report

Goals and scope, Functional unit and Stakeholders. The ultimate goal of an S-LCA is to improve social conditions and the socio-economic performance associated with a product throughout its life-cycle. The more immediate goal is to identify “Social Hotspots” and options for reducing negative impacts through product development and substitution in the supply chain.

The Guidelines suggest five Stakeholder groups, shown in the left column of Table 1:

- *Workers* involved in producing and distributing the product;
- *Consumers* that use it and, often, dispose of it at end of life;
- the *Local Community* directly involved with these actions;
- the surrounding *Society* in providing the stage for these actions;
- and what you might call “*Any other interested party*” – shareholders, NGOs or the State, for instance.

Table 1. Stakeholder groups and Impact categories (UNEP/SETAC Report 2009, Table 3, p.49)

Stakeholder groups	Impact categories
Workers	Freedom of Association and Collective Bargaining Child Labour Fair Salary Working Hours Forced Labour Equal opportunities/Discrimination Health and Safety Social Benefits/Social Security
Consumers	Health & Safety Feedback Mechanism Consumer Privacy Transparency End of life responsibility
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
Society	Public commitments to sustainability issues Contribution to economic development Prevention & mitigation of armed conflicts Technology development Control of corruption
Other value-chain actors	Fair competition Promoting social responsibility Supplier relationships Respect of intellectual property rights

Social Life-Cycle impact inventory. A social impact is one that alters the way people live, work, relax and relate to each other. The UNEP guidelines suggest the 31 impact categories shown in the right-hand column of Table 1 broadly relating to

- Human rights and equity
- Health and safety
- Working conditions and fair pay
- Freedom of speech and association
- Social support and welfare
- Good governance and control of corruption
- Wellbeing in the broadest sense

The social impact inventory itemises how stakeholders are affected (or might be affected) by the sourcing of materials for the product, its manufacture, use and disposal. Nations differ in the norms, standards and respect that they commonly apply in dealing with social impacts, so the geographical location in which each of these phases of life takes place is an important input in making the inventory.

Social Life-Cycle Impact assessment. The interactions identified in the Inventory step can have both positive and negative consequences. The aim of impact assessment is to flag Social Hotspots – points of contact between stakeholders and aspects of the manufacture, distribution and use of the product that may, potentially, be damaging or could be influenced in a positive way.

Interpretation and options for action means seeking patterns in the distribution of Hotspots across product life and Stakeholder groups, prioritizing options for action and making recommendations that reduce social friction or inequity and enable constructive change.

Wider implications. If the actions are implemented, what consequences follow? What are the synergies and conflicts with competing environmental and economic components of sustainability assessment, shown as circular arrows on Figure 1?

What is S-LCA used for? S-LCA is a management tool. It draws on imprecise data, much of it qualitative rather than quantitative. Unlike environmental LCA, S-LCA does not deliver numerical outputs but instead identifies Social Hotspots flagging aspects of product life that might harm human welfare or allow improved well-being of the individuals and communities touched by it. Proponents see it as contributing to the following activities:

- Informing decision-making in product development and establishing material supply chains
- Comparison of different options for products and services
- Comparison and bench-marking of suppliers
- As a basis for certification and labelling
- As input to Corporate Sustainability Reporting
- Marketing and communication

3. Eco Audits, Social Impact Audits and the Social Impact Audit Tool

An Eco Audit is an approximate environmental appraisal of the material resources, energy and carbon footprint associated with the life of a product. It is not a full LCA – it is much less rigorous than that – but it is fast, easy to perform and able to flag the first-order consequences of a change of material, manufacturing route, transport mode, use pattern and disposal choice. It is a design tool, not a product assessment tool.

The CES EduPack contains a simple Eco Audit Tool. The advanced version of the tool includes an approximate Cost Audit. Here we describe a simple EXCEL-based Social Impact Audit Tool that complements⁸ the tools already provided in CES EduPack and offers an introduction to S-LCA methods and thinking. The EXCEL Tool contains data from Nations of the World Data-table from CES EduPack Sustainable Development Database⁹.

A “bottom-up” approach to the assessment of the impact of product manufacturing on people and their social interaction starts at the Enterprise level, exploring working conditions and welfare within the production plant and expanding outwards to suppliers and the surrounding community. Such studies, which form part of Corporate Sustainability Reporting (CSR), require local information that may be unavailable in the public domain. Lacking this detail, useful conclusions can still be drawn from a “top-down” analysis of national scope.

Governments and NGOs with international perspective assemble global statistics on social issues that relate, directly or indirectly, to the impact categories of Table 1. The World Bank¹⁰, for example, assembles data for population, GDP, employment, political stability, and control of corruption. The OECD¹¹ compiles data for conditions of work, national finance and the environmental legislation of most of the world’s nations. The United Nations¹² publishes annual statistics documenting human development, education and health, listed by nation. There are many more such sources.

The impact categories of Table 1 can be mapped onto these data sources, using them as metrics of social impact. It is then possible to flag, for each phase of life, impact categories in which conditions within the relevant nation fall significantly below best-practice or (conversely) where change of operation could bring constructive change. Table 2 gives an idea of how the mapping works for one of the five stakeholder groups and their associated impact categories. Appendix A provides the full mapping exercise.

Table 2. Example of mapping impact categories onto available data sources

Stakeholder group	Impact category	Mapped to data source
Workers (group 1)	Freedom of association Child labor Forced labor Fair salary Working hours Equal opportunity/Discrimination Health and safety Social security/Benefits	ITUC Freedom of association Child labor Forced labor and slavery Minimum wage Hours worked per year Women's share of work force Fatal accidents at work Social protection expenditure

⁸ The feedback collected from the users of the Social Impact Audit Tool will help in implementation of this Tool in GRANTA’s CES EduPack software.

⁹ CES EduPack Sustainable Development Edition, <https://grantadesign.com/education/ces-edupack/editions/#edition-17>

¹⁰ The World Development Indicators, <https://data.worldbank.org/products/wdi>

¹¹ OECD.Stat, <https://stats.oecd.org/>

¹² UNSD Databases, <http://data.un.org/>

The sources use a variety of scales, some a simple ranking (the UN Development Index is an example), some using quantitative data (such as GDP per capita). We have converted all into ranked lists and rescaled these ranking to span the range 1 (least-good practice) to 100 (best practice) in the following way. When the source ranking is such that the lowest value (x_{min}) is the least good and the greatest (x_{max}) is the best, the rescaling to a value y with a range 1 – 100 uses the equation:

$$y = \left(\frac{99}{(x_{max} - x_{min})} \right) x - \frac{(100x_{min} - x_{max})}{(x_{max} - x_{min})}$$

When, instead, the source ranking is such that the lowest value (x_{min}) is the best and the greatest (x_{max}) is the least good, the rescaling takes the form:

$$y = \left(\frac{-99}{(x_{max} - x_{min})} \right) x + \frac{100x_{max} - x_{min}}{(x_{max} - x_{min})}$$

After ranking and scaling, the lists are no longer integers (if 190 nations are ranked and scaled 0 – 100, some have fractional rankings).

Why do that? The idea is to make maximum use of the information these sources contain in a neutral but comparable way, avoiding any overlay with further subjective judgements. The scaled rankings are stored for each impact category as a look-up table that the tool can access (Figure 5). Binary distinctions (e.g. Death penalty) are ranked as either 1 (penalty exists) or 100 (penalty abolished). It could be argued that assigning polarity to the end points (“Best practice”, “Least good practice”) implies judgement on our part but this is already implicit in the sources used for mapping, almost all of which detail their criteria. The source itself can be accessed by clicking on the source title in the header in the Excel table. If a Social Hotspot threshold – a point on the 1 to 100 good-practice scale – is set, nations with “good-practice” values below the threshold will be flagged.

5 Stakeholder groups, 31 Social Impact Categories →

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

Figure 5. A small part of the look-up table of Nations and Social Impact Categories data.

Figure 6 shows how this works for two of the life phases – *Materials* and *Manufacture* – for a hypothetical product using material sourced from Australia, subsequently manufactured in Bangladesh. The red markers show the scaled rankings for two impact categories for each stakeholder class (there are, of course, more – see Table 1). The threshold is set at 25%. The tool identifies impact categories for which the quality of practice in that nation falls in the bottom quarter of that of all nations. As illustrated here, in Australia national practice in almost all impact categories is good. In only one, the national Ecological footprint, does it fall below the threshold. In Bangladesh, national rankings for Fair wages, Hours worked, Health and Safety and IP protection fall below the threshold. Where this happens, the impact category is flagged as a Social Hotspot.

This does not mean that any specific enterprise in either nation allows poor practice, just that, viewed nation-wide, practice in three quarters of the world (according to the source) is better.

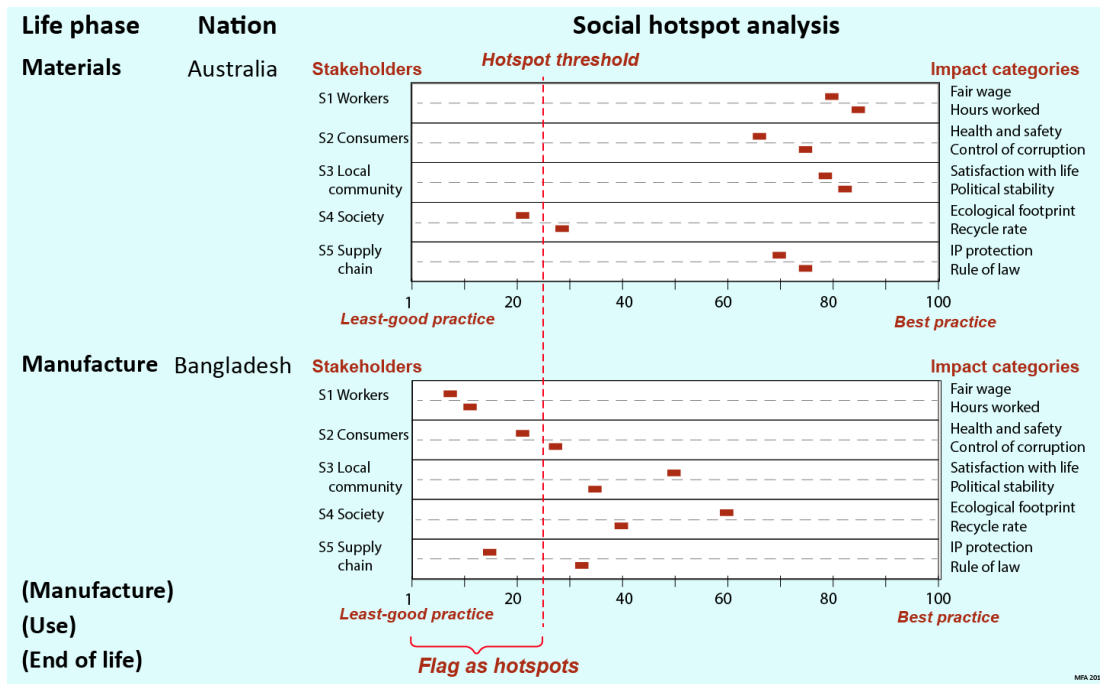


Figure 6. The underlying analysis carried out by the Social Impact Audit Tool.

Implementation in Excel

The Source table illustrated in Figure 5 is contained in a spreadsheet of the Excel tool. The tool is used in the following way.

A. Impact inventory: Identify potential Social Hotspots.

1. Identify the Nations from which the materials used in the product are sourced, the Nation in which it is manufactured, where used and where processed at end of life by clicking the check box on the left of its name. The row colors green to indicate selection (upper frame of Figure 7).

2. Click the “Set threshold limit” tab at the upper left. The user is prompted to set a Social Hotspot threshold – the percentile of quality-of-practice below which concern might be felt for the wellbeing of one or more stakeholder group. All impact categories with good practice rankings below the threshold turn red (lower frame of Figure 7).

3. Click on the “Copy rows to Report” tab at the upper left to consolidate the data. The selected nations with their red-highlighted Hotspots are copied to a report page of the spreadsheet. All other Nations are omitted.

4. Transcribe the nation short-names and the number of Hotspots per stakeholder group into the table in the Report (Figure 8).

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

Figure 7. Selecting Nations. Setting the Social Hotspot threshold.

Vertical: Hotspot distribution across life-phases

↓

Life phase	NATION	S1 Workers	S2 Consumers	S3 Local community	S4 Society	S5 Supply chain (others)
Material	AUS				X	
Manufacture	BGD	XXXX	XX	XXXX	X	X
Transport	PAN	X	XX	XXXX	X	
Use	SUI				X	
End of Life	KEN	XXXX			XX	X

Horizontal: Hotspot distribution across stakeholders

Figure 8. Social Hotspots summary table.

B. Impact assessment.

5. High level overview: survey the Social Hotspots table by column and by row to identify any stakeholder group or phase of life that merits particular attention (Figure 8).

6. More detailed review: survey the flagged individual impact categories noting opportunities or significant concerns. Each impact category name (top row of Figure 5) is linked to information about the source from which the data were drawn. Clicking on the name brings up a brief description and the URL to the source itself, allowing deeper exploration (Figure 9).

Women's share of labor force

UNEP Impact Category: *Equal opportunities / Discrimination*

Women's Share of Labor Force is the percentage of the total workforce of a State that is currently filled by female employees. It gives some idea of how equally the workforce is distributed between the sexes but does not take into account the nature of the employment or the difference in salary between women and men.

See: <https://data.worldbank.org/indicator/SL.TLF.TOTL.FE.ZS>

Figure 9. Example of the provided notes for each impact category

7. Explore "What if...?" options. How sensitive is the Social Hotspot list to the choice of threshold value? Would a change of material or of Nation for one or more phases of life greatly reduce the Hotspot count or severity?

C. Report on findings and options for action.

8. Consider possible environmental and economic consequences of chosen social actions.

Actions to improve social-economic performance across supply chain, for example:

- Joint action with stakeholders to improve education, health care and housing;
- Partnership agreements to share management and ownership;

Actions involving adjustment to supply chain:

- Change of provider because of irredeemable corruption, conflict or political instability;
- Damage limitation: action to offset negative publicity.

The aim of the final report is to inform decision-makers responsible for product development or as a part of due diligence work and as a first step of supply-chain analysis, or as an input to corporate sustainability reports. See Appendix B for more information.

4. Case studies

The way the method works is best illustrated by case studies.

Case study 1: A cotton T-shirt

The Life-Cycle of the yellow T-shirt shown in Figure 10 involves five nations:

- Material: the cotton, grown in Australia
- Manufacture: the weaving to cloth and T-shirt production in Bangladesh
- Transport to Europe by shipping under Panamanian jurisdiction
- Sold and used over 3 years in Switzerland
- Sent to Kenya at end of first life



Figure 10. A T-shirt.

A Hotspot analysis with the threshold set at 10% flags seventeen potential impact categories that merit further exploration. Australian society is flagged because of its high Ecological Footprint. Working conditions in Bangladesh include the use of child labor, low wages, long working hours and public health provision that fall in the bottom 10% of those of all nations. Working conditions in Panama and Kenya are flagged, where child labor, high unemployment and political instability are also concerning. The data sources for each of these impacts can be accessed from the header of the column in the Excel spreadsheet.

	NATION	Workers	Consumers	Local community	Society	Supply chain (others)
Material	AUS				X	
Manufacture	BGD	X X X X	X	X		
Transport	PAM	X				
Use	SUI					
End of life	KEN	X X		X X		

Figure 11. The Social Hotspot summary table for the T-shirt with threshold set at 10%

The Social Hotspot summary (Figure 11) shows a number of clusters. Among stakeholder groups, workers and local communities are most at risk. Two life phases – Manufacture and End of life, both involving developing nations – account for almost all the flags. These would disappear if, for instance, Australia both produced the cotton and made the T-shirts (but with likely economic penalties) and if the T-shirts were recycled in same nation in which it is used, Switzerland. This move from developing to developed nation, however, ignores potential hardship caused by loss of jobs in Bangladesh and Kenya where “High unemployment” is flagged as a Hotspot.

Case study 2: An electric toaster

The toaster shown in Figure 12 is made of chromium-plated steel with nickel-chrome alloy heating elements. Its Life-Cycle starts with the mining of iron ore in Australia, chromium in South Africa, nickel in Indonesia and the synthesis of PVC in South Korea where the product is also manufactured. The toasters are shipped via Singapore by a Singaporean company to the United Kingdom where they are sold and used. At the end of life they are shipped to India for reconditioning or recycling. Figure 13 shows the Social Hotspot summary when the threshold is set at 20%, flagging impacts that lie in the bottom fifth of the “Least-good to Best-practice” spectrum.



Figure 12. A toaster.

	NATION	Workers	Consumers	Local community	Society	Supply chain (others)
Materials 1 - Iron	AUS				X	
Material 2 - Chromium	RSA	X		X		
Material 3 - Nickel	INA		X	XXX	X	X
Material 4 -PVC	KOR				X	
Manufacture	KOR				X	
Transport	SIN		X X	X	X	X
Use	GBR					
End of life	IND	X X X	X	X X X	X	X

Figure 13. The Social Hotspot summary table for the toaster with threshold set at 20%

Long working hours, forced labor and slavery, and high unemployment flagged for South Africa. Indonesia's ranking for Public health provision and Intellectual property protection lie in the bottom fifth of all Nations. South Korea, like Australia and the United Kingdom, are flagged because of their high Ecological Footprint. Freedom of the press is limited in Singapore. Wellbeing in India is flagged as at greatest risk because of length of working hours and low pay, the low fraction of women in the workforce and public health provision.

The pattern of Social Hotspots suggests that the most widespread problems with the set of Nations associated with this product are societal (second last column) and with the way end-of-life is handled, emphasizing the need for developed nations take greater responsibility for the management of recovery and recycling.

5. Summary and Conclusions

The Social Impact Audit Tool, implemented in Excel, described in this paper is simple, fast and gives insight into the multi-dimensional social aspects of product life. It draws on a large body of socially-relevant data compiled by International Agencies and NGOs with respected pedigrees and which is regularly updated. The underlying procedures are consistent with those proposed in the UNEP "Guidelines for Social Life-Cycle Assessment of Products", which are widely accepted as the starting point for any S-LCA study.

The tool has limitations. The most severe is that desktop-screening at the National level gives no insight into site-specific issues. This requires on-site investigation of the social and socio-economic of product's life, something that is also difficult, time consuming and for which much information is not in the public domain.

Despite this considerable limitation, the social auditing of product life has value as an educational tool. It provides a fast, approximate snap-shot of potential Social Hotspots, viewed from a top-down, nation-wide perspective. It and its case-studies can be used in a number of ways.

- As an introduction to the human and social impacts of the Life-Cycle of products.
- As a lead-in to S-LCA methods and impact categories detailed in the UNEP/SETAC Guidelines.
- Uniquely, to allow students to explore a full Life Cycle Sustainability Analysis, meaning a coupled eco-audit, cost-audit and social-audit all performed for the same product. For instance, by using CES EduPack for the first two audits.

In closing, it is worth re-emphasising the goal of a Social Life-Cycle Assessment: It is to highlight and ultimately improve social conditions and socio-economic performance associated with a product throughout its life. The Assessment identifies Social Hotspots: point of contact between stakeholders and aspects of the materials, manufacture, distribution and use of the product that may, potentially, be damaging or could be influenced in a positive way.

6. Further Reading

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Appendix A: Mapping of Impact categories to available sources

Stakeholder group	Impact category	Mapped to data source
Workers (group 1)	Freedom of association Child labor Forced labor Fair salary Working hours Equal opportunities/Discrimination Health and safety Social security/Benefits	ITUC Freedom of association (1) Child labor (2) Forced labor and slavery (3) Minimum wage (4) Hours worked per year (5) Women's share of work force (6) Fatal accidents at work (7) Social protection expenditure (8)
Consumers (group 2)	Health & Safety Feedback Mechanism Consumer Privacy Transparency End of life responsibility	Public health spend*GDP/capita (9) Press freedom (10) Rule of law (11) Corruption perception index (12) Recycle rate (13)
Local community (group 3)	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	GDP per capita (14) Total literacy, Public expenditure In Education (15) Wellbeing, Satisfaction with life (16) - Public health expenditure per capita (18) Political freedom and Civil rights (19) Voice and accountability (20) Unemployment rates (21) Political stability (22)
Society (group 4)	Commitment to sustainability Economic development Technology development Mitigation of armed conflict Corruption	Ecological footprint (24) UN Human Development Index (25) R&D spend (26) Global Peace Index (27) Control of corruption index (WB) (28)
Other value-chain actors (group 5)	Fair competition Promoting social responsibility Supplier relationships Respect of intellectual property rights	Regulatory quality (29) Good Country Index (30) Regulatory quality (29) Global IP Index (32)

Workers (group 1)	
1	https://www.ituc-csi.org/IMG/pdf/survey_ra_2014_eng_v2.pdf
2	file:///C:/Users/User/Downloads/World_Report_on_Child_Labour_EN_Final_Web.pdf https://ourworldindata.org/child-labor
3	http://humantraffickingsearch.org/top-countries-modern-day-slavery/ https://www.globallslaveryindex.org/findings/
4	https://en.wikipedia.org/wiki/List_of_minimum_wages_by_country
5	https://stats.oecd.org/index.aspx?DataSetCode=ANHRS ; https://data.oecd.org/emp/hours-worked.htm
6	https://data.worldbank.org/
7	https://sites.google.com/site/ryoichihoriguchi/home/occupational_fatality_by_county
8	https://www.oecd-ilibrary.org/social-issues-migration-health/society-at-a-glance_19991290
Consumers (group 2)	
9	https://www.indexmundi.com/facts/indicators/SH.XPD.PUBL.ZS/rankings
10	https://rsf.org/en/ranking/2018#
11	www.govindicators.org
12	https://www.transparency.org/news/feature/corruption_perceptions_index_2017
13	https://resource.co/sites/default/files/World%20Recycling%20League%20-%20Full%20Report%20-%20FINAL.pdf
Local community (group 3)	
14	https://www.cia.gov/library/publications/the-world-factbook/rankorder/2004rank.html
15	http://world.bymap.org/LiteracyRates.html ; http://hdr.undp.org/en/content/expenditure-education-public-gdp
16	https://en.wikipedia.org/wiki/Satisfaction_with_Life_Index
17	-
18	https://www.indexmundi.com/facts/indicators/SH.XPD.PUBL.ZS/rankings
19	https://freedomhouse.org/content/freedom-world-data-and-resources
20	https://www.indexmundi.com/facts/indicators/SH.XPD.PUBL.ZS/rankings
21	https://goodcountry.org/index/overall-rankings
22	http://info.worldbank.org/governance/wgi/#reports
Society (group 4)	
23	www.footprintnetwork.org ; http://data.footprintnetwork.org/#/abouttheData
24	http://hdr.undp.org/en/ http://data.footprintnetwork.org/#/abouttheData
25	http://hdr.undp.org/en/
26	www.govindicators.org
27	http://visionofhumanity.org/app/uploads/2017/06/GPI17-Report.pdf
Other value-chain actors (group 5)	
28	www.govindicators.org
29	https://rsf.org/en/ranking/2018#
30	https://goodcountry.org/index/overall-rankings
31	http://www.theglobalipcenter.com/wp-content/uploads/2017/02/GIPC_IP_Index_2017_Report.pdf

Appendix B: Actions that might follow a Social Impact Audit

The first step is to understand the motives of the company under consideration. How collaborative are its actions in relation to key stakeholders. Are they merely transactional or procedural, or are they genuinely collaborative? (see definitions below, based on MIREU model¹³).

Collaborative
Co-planning; Capacity building; Educational and Awareness-raising programmes; inclusion; participation; local procurement generating income for local communities; passive joint monitoring; promotion of renewable energy and efficient use of resources; compliance with the most rigorous environmental standards.
Transactional
Stakeholder inputs sought and implemented; active joint monitoring; awareness raising campaigns; participation in relevant networks; adequate opportunities for Public participation; transparent, legal behavior; community convinced that the burden of impacts is outweighed by the benefits of the project.
Procedural
Land use conflicts; Threat to livelihoods; “no-go” zones; type of commodity (coal, uranium etc.); Little visibility and threat of eco impacts and too complex mitigation measures; Poor community engagement; Poor working conditions incl. health and safety, working hours and pay.

The second step is to implement actions based on the underlying motivation. The impact and measures undertaken can happen upstream (suppliers in areas of operation / wider social goals etc.) and downstream (customers, e.g. opportunities for domestic recycling; product end-of-life potential, its multiple lives).

The Company concerns include social risk, potential reputational risk strategies to reduce risk-exposure. The questions asked could include. Which regions in which the Company operates have Social Hotspots? What actions are implemented or avoided? Which educational activities could be introduced? Are there any specific opportunities for social investments, such as investments in a clean water, sanitation, schooling, health, housing, training etc. Are there conditions which justify a change of a provider, such as irredeemable conditions arising from conflict, corruption or political instability, which carry reputational risk?

¹³ <https://kuleuven.sim2.be/ensuring-the-slo-concept-is-adaptive-and-resilient/>, a workshop, where the outcomes from <https://mireu.eu/> were presented.

Appendix C: CES EduPack Sustainability Database

The Nations of the World Data-table of the CES EduPack Sustainability Database assembles social, socio-economic and environmental data for the 203 Nations of the World. All the information it contains is accessible from open sources, but it is dispersed. The United States Geological Survey (USGS) and the British Geological Survey compile data for material production and countries of origin. National and international agencies such as the United Nations, the World Bank and the CIA assess the demographic, economic and governance performance of nations. The US Department of Energy, the US Department of Defense, and the European Union publish analyses of the economic role and importance of materials and assign “critical” or “non-critical” status to them. The US Department of Energy (DOE) International Energy Agency (IEA), the Environmental Protection Agency (EPA), the Electric Power Research Institute (EPRI) publish analyses of renewable energy and energy storage systems. There is no shortage of sources with provenance but many of them take the form of long reports in which the information that is sought lies hidden. Assembling it into a single, cross-linked network makes access much easier and frees time to explore alternative scenarios in depth. The CES EduPack Nations of the World Data-table does this, storing the data in the units in which they appear in the sources, not in the ranked and scaled form used by the Excel tool described in this paper. The Data-table is maintained by the ANSYS Granta Academic Relations team with regular updates.

The CES EduPack software allows data to be plotted as charts bringing out trends and relationships. Three are shown here as illustrations of the ways in which social links can be explored. Figure C1 illustrates how the ecological impact per capita correlates with national wealth. Figure C2 shows the strong correlation between the resources allocated to social support (public health, unemployment benefits and the like) and national wealth, rising from around 3% of GDP in the poorest nations to about 12% in the wealthier. Figure C3 is a chart of the World Bank Control of Corruption index against a metric, updated annually, of Press Freedom. Here the correlation is much looser, but it is still evident that an unconstrained press is a catalyst for reducing corruption, particularly when single geographical groups (those with the same color on the chart) are examined.

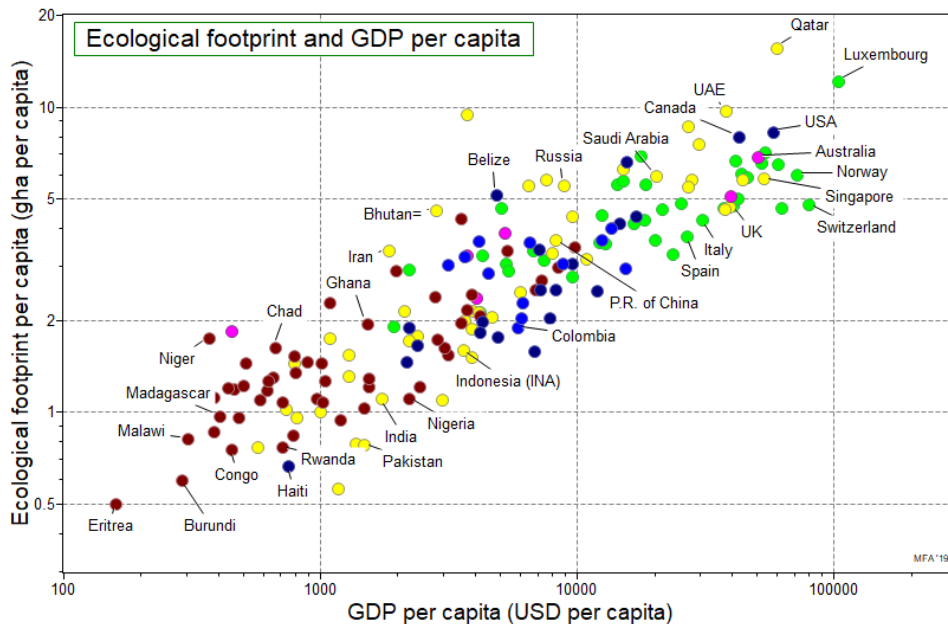


Figure C1. The ecological footprint of Nations and their GDP per capita.

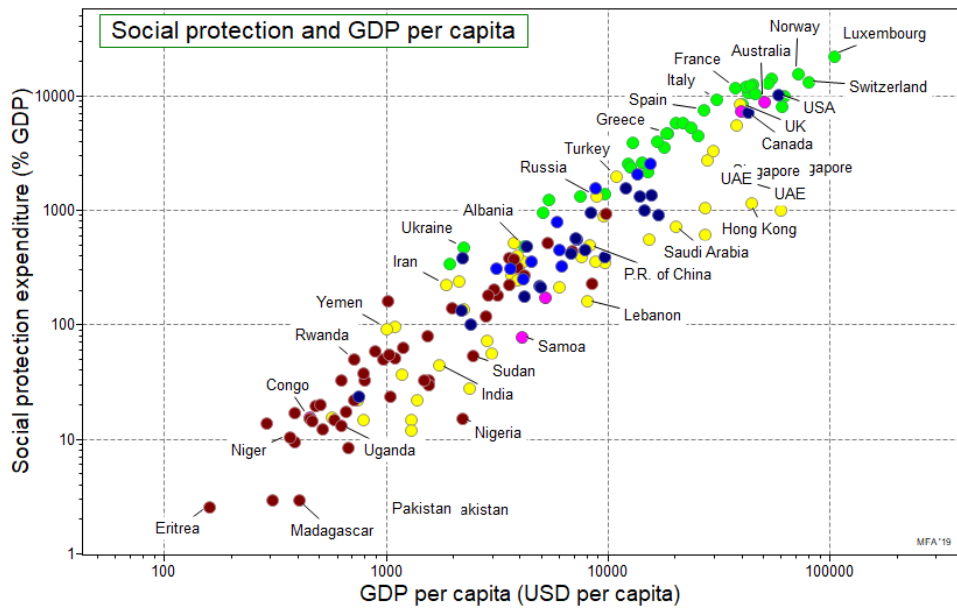


Figure C2. The Social Protection provided by Nations and their GDP per capita.

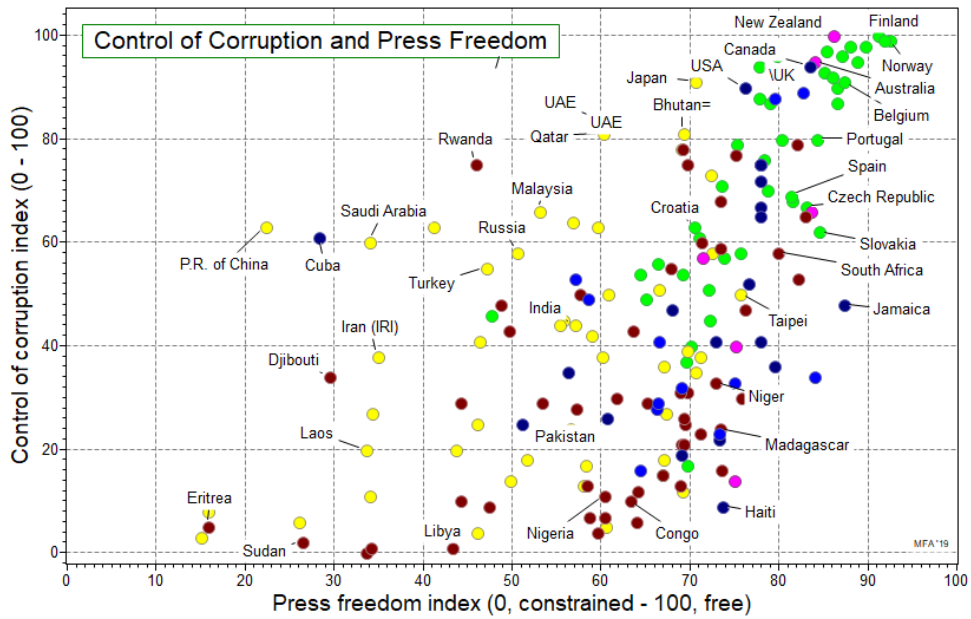


Figure C3. The World Bank Control of Corruption index and the Reporters without Borders Press Freedom index.

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Granta's Teaching Resources website aims to support teaching of materials-related courses in Engineering, Science and Design.

The resources come in various formats and are aimed at different levels of student. This resource is part of a set of resources created by Professor Mike Ashby and Granta Design to help introduce materials and materials selection to students.

The Teaching Resources website also contains other resources donated by faculty at the ~1000 universities and colleges worldwide using Granta's CES EduPack and includes both resources that require the use of CES EduPack and those that don't.

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