SCORELCA

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MULTI-CRITERIA EVALUATION METHODS FOR ENVIRONMENTAL, SOCIAL AND ECONOMIC ASPECTS

SUMMARY

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Scientific Director - Bernard De Caevel
Co-authors: José Rafael Dulbecco, Tom Huppertz (RDC Environment)
in collaboration with Alessandra Zamagni (Ecoinnovazione)

SCORE LCA is an association that has been created to financially support collaborative research on Life-Cycle analysis (LCA) and related topics. It aims to promote and organize cooperation between companies, institutional and scientists in order to support the evolution of LCA methods and its practical implementation at European and international level.

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SUMMARY

Sustainable development can be assessed quantitatively and qualitatively through multi-criteria assessment methods. The objectives of this study are to conduct a comprehensive critical analysis of multi-criteria assessment methods, to assess their applicability and relevance to practitioners' objectives, and to provide a practical guide to help practitioners choose the right method for their study objectives. Twenty-three methods were first analysed in a cross-sectional manner, and then three were selected for in-depth analysis: Cost-Benefit Analysis (CBA), Life Cycle Sustainability Analysis (LCSA) and the Composite Sustainability Performance Index (CSPD). The three methods were chosen because of their holistic nature in addressing the key pillars of sustainability and life cycle. Furthermore, the choice of methods was made in such a way as to consider methods with a diversity of implementation objectives: the evaluation of products, projects (including public policies) and organisations.

KEY WORDS

Multi-criteria evaluation method, Sustainable development, Cost-benefit analysis, Life Cycle Sustainability Analysis, Composite Sustainability Performance Index

TABLE OF CONTENTS

1 Introduction

1.1 Context

The evaluation of products, projects and organisations with regard to sustainable development is a key approach to decision support in the private and public sectors. Assessing the social, environmental and economic impacts (collectively referred to as societal impacts) of the object of study enables the actors commissioning the assessment to understand the potential effects of the latter in order to try to increase the positive societal impacts and reduce the negative ones, and thus to be part of a sustainable development approach.

Sustainable development can be assessed quantitatively and qualitatively using multi-criteria evaluation methods. Since the concept of sustainable development was formalised in 1992 at the Earth Summit in Rio, these multi-criteria evaluation methods have multiplied, in concomitance with the increasing importance that public and private actors have given to sustainable development.

In view of this multiplication of methods, and therefore of the alternatives for practitioners when it comes to choosing one, it is appropriate to provide guidance to facilitate this choice.

Three methods are presented in this guide:

- Cost-Benefit Analysis (CBA);
- Life Cycle Sustainability Analysis (LCSA);
- Composite Sustainability Performance Index (CSPI).

1.2 Objective

To provide a practical guide to help practitioners choose among the above-mentioned multi-criteria assessment methods.

2 What methods are analysed?

2.1 Cost-Benefit Analysis

OBJECTIVES OF THE METHOD

The main objectives of a CBA are the following.

1) Compare different scenarios:
   - Should the project under consideration be implemented, or which of several alternative projects should be selected? (ex-ante)
   - What was the impact of the project (ex-post)
2) Consider societal impacts in order to:
   - Assess the benefit to society ("total net benefit/cost")
   - Identify the beneficiaries and losers of the different scenarios considered, in space and time.

The goal is to allocate resources efficiently (economically, environmentally and socially).

TYPE OF IMPACTS ASSESSED

The impacts that the method seeks to evaluate are all the economic, environmental and social consequences of a decision (such as the marketing of a product, the implementation of a project or the setting up of a public policy) that impact the well-being of the actors affected by it. Some impacts are

already quantified in monetary units, others are not (such as externalities[1]). The practitioner of cost-benefit analysis must monetise the latter. As far as the final results are always expressed in monetary values, the impacts can be characterised as quantitative.

APPLICATION EXAMPLES

For example, a CBA could be used to assess the societal benefit of building a solid recovered fuel (SRF) facility; following this example, if the assessment determines that there is a societal benefit to building such a facility but that the economic pillar shows a deficit, the CBA could conclude that there is a case for subsidising the facility to cover the deficit and unlock the environmental and social gains. CBA can also be useful for public policy decision-making, for example deciding whether to introduce a deposit scheme for reuse of packaging if such a system shows a positive societal balance.

2.2 Life Cycle Sustainability Analysis

OBJECTIVES OF THE METHOD

- Identify the hot spots in the value chain (i.e., the links that have the most impact) and thus:
  - Stimulate innovation to try to improve the stages of the product life cycle;
  - help decision-makers prioritise and invest resources in a way that maximises positive impacts;
  - to raise awareness of the challenges of sustainable development among those actors in the value chain who have a significant negative impact.
- Inform labelling initiatives and thus guide consumers towards sustainable products (not just cost-effective, eco-efficient or socially responsible).

TYPE OF IMPACTS ASSESSED

LCSA considers all stages of the product life cycle and all attributes of environmental, economic and social interventions at each stage. According to UNEP (2011), this overview allows "the identification and possible avoidance of unintended shifting of environmental burdens, economic benefits and social well-being between life cycle stages".

- VCA: assessment of economic costs and benefits as well as possible externalities that have been internalised by market or regulatory mechanisms (e.g., pollution taxes).
- LCA: assessment of the environmental impacts of each elementary process[2] included in the boundary of the system under study. As stated in ISO 14044:2006, "the data collected, whether measured, calculated or estimated, is used to quantify the inputs and outputs of an elementary process".
- ASCV: Assessment of "social and socio-economic aspects of products and their potential positive and negative impacts throughout their life cycle. The aspects considered are those that can (in)directly affect stakeholders. They can be related to business behaviour, socio-economic processes or impacts on social capital".[3] While the impacts considered in LCA and VCA are quantitative and semi-quantitative, ASCV also takes into account qualitative impacts.

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[1] Consequence of an activity that affects stakeholders other than the organisation responsible for the activity, for which the organisation is neither compensated nor penalised through markets or regulatory mechanisms (ISO 14007/2019 - Environmental management - Guidelines for the determination of environmental costs and benefits)

[2] According to ISO 14044:2006: "smallest part considered in the life cycle inventory for which input and output data are quantified".

[3] UNEP. (2011). Towards a Life Cycle Sustainability Assessment

https://wedocs.unep.org/handle/20.500.11822/8001

APPLICATION EXAMPLES

A LCSA -type assessment could, for example, enable a producer of electric mobility batteries to identify the hot spots in its value chain to guide its choice of suppliers. The LCSA could also be used to communicate internally or externally (to value chain partners, customers, competitors, regulators, other stakeholders) on the sustainability of the product in question.

As far as public authorities are concerned, it is likely that they are not the ones who conduct the LCSA, but rather the ones who use the information that these assessments produce or who request that such assessments be carried out (in some cases). Indeed, the information from the LCSA can be directly used for the development of sustainability criteria in sustainable product policy tools (e.g., eco-design, energy label/ecolabels, green public procurement). In this sense, an example of using LCSA information could be to facilitate the choice between two alternative products/services according to sustainability criteria.

2.3 Composite Sustainability Performance Index

OBJECTIVES OF THE METHOD

The objectives of the CSPI are to

- to inform investors and companies in terms of sustainable investment;
- create long-term shareholder value by seizing opportunities and managing risks arising from economic, environmental and social developments;
- to exploit the market potential for sustainable products and services;
- set ambitious and consistent targets taking into account current performance;
- Stimulate the commitment of the organisation's stakeholders (e.g., shareholders, employees, suppliers) and raise their awareness of sustainable development issues.

TYPE OF IMPACTS ASSESSED

The method seeks to assess the impact of the company's activities through economic, environmental and social indicators, known as key sustainability performance indicators (KPIs). These reflect the three pillars of sustainable development but vary from one company/industry to another[4] . They can be quantitative, semi-quantitative and qualitative.

APPLICATION EXAMPLES

An assessment of the CSPI type can enable an organisation, a company for example, to have synthetic and general information on the orientation of its activities in terms of sustainable development. In addition to enabling the company's activities to be steered towards sustainable development, the CSPI can also be used to communicate with shareholders, employees, suppliers, etc. on its sustainable development approach.

[4] Two other dimensions of sustainable development can be included: organisational governance and technical aspects.

3 Cross-sectional analysis

This section presents a cross-sectional analysis of the three methods studied on key comparison criteria.

3.1 Analysis of key criteria

Table 1 Cross-sectional analysis of methods

Aspect	Cost-Benefit Analysis (CBA)	Life Cycle Sustainability Analysis (LCSA)	Composite Sustainability Performance Index (CSPI)
Subject of study	Project	Product	Organization
Single result	Yes	Depends on methodological guides	Yes
Strict methodological framework	No	Yes	No
Consistency vs. methodological relevance	Relevance	Relevance	Relevance
Encompassing character (vs. conscript)	Yes	Yes	No
Weighting of pillars and impacts	Yes, weighted by monetary valuation	Depends on methodological guides	Yes, dedicated weighting method
Integration of LCA	Average	Strong	Low
Difficulty of application	Average	High	Low

The results of Table 1 are discussed below.

PURPOSE OF THE STUDY

The object of the study is the object generating the impacts that the practitioner seeks to evaluate. Three categories of objects have been defined: project, product or organisation. Projects include infrastructure investments but also public policies. Products include both goods and services. Organisations correspond to companies, public authorities, etc. conducting an activity and therefore generating impacts.

In this respect, the three methods are not exclusive to the objects of study indicated in the table above. Indeed, there is flexibility; for example, a cost-benefit analysis could be used to evaluate a product. What is meant in the first row of Table 1 is to give the most appropriate method for the different objects of study.

The study objects listed in Table 1 correspond to those for which the methods were originally designed according to the authors of the reference materials used in this study (see section 2).

The line between CBA and LCSA in terms of the object of study is less clear than that between these methods and the CSPI. CBA focuses more on the final effects that the object of study has on individuals in a society and pays less attention to the processes/stages of the life cycle. Indeed, in CBA, the practitioner will aggregate the costs of a value chain to obtain a final cost (e.g., the cost of steel) instead of looking at each link and process in the value chain (iron ore extraction, blast furnace, etc.). On the

other hand, LCSA will have a finer granularity in terms of process analysis and life cycle stages. In summary, the CBA perspective is more macro-analytical and the LCSA perspective is more micro-analytical. The macro-analytical perspective is more suitable for making 'go/no-go' decisions on an investment project or public policy based on the benefit (or not) to society. The micro-analytical perspective is better suited to an assessment approach for identifying hotspots in the value chain of a given product with a view to optimising the societal impacts of the product.

SINGLE RESULT

A single outcome implies the calculation, or the possibility of calculation, of an outcome encompassing the set of impacts assessed and expressed by a single unit.

Methods that aim to calculate a single result are:

- CBA, which requires the monetisation of non-monetary impacts in order to express the overall results in monetary units (€ of welfare);
- the CSPI, which provides for the calculation of a single score by aggregating all economic, environmental and social indicators (Z-score and AHP method, see Annex 5).

As for the LCSA, there are discrepancies between the methodological guides. The first formalise the LCSA does not foresee the calculation of a single result. The methodology proposed by the ORIENTIGN project (see the "Reference systems" section of the detailed report), will provide guidance on how to integrate/combine the results.

It should be noted that one of the strengths of methods with a single outcome is that it makes it easier to understand the outcome. Multiple outcomes, defined in different metrics, can make it more difficult to understand and interpret the results, and multiple outcomes can also make it more difficult to draw general conclusions about the subject matter.

STRICT METHODOLOGICAL FRAMEWORK

Strict methodological framing implies that the practitioner must follow certain steps and rules when applying the methods. Methodological frameworks have been identified for all three methods, but the level of flexibility in the framing is different. For LCA, several guides have been published (e.g., ILCD manual, PEFCRs for different product categories) that aim to limit the flexibility of value choices in modelling. Furthermore, LCA is the only standardised method for environmental impact assessment at the product level, while standardisation activities are underway for ASCV. In contrast, CBA and CSPI are based on methodological guides that manifest the principles of the methods but do not impose a fixed framework to be followed.

Methods where the practitioner has more flexibility in terms of methodological and reporting principles (or even data/approach transparency requirements), may make it more difficult to replicate the results; this is due to the subjective choices that practitioners may make (e.g., when using a CBA monetisation model[5]). On the contrary, methods with a strict framework can favour the replicability of results.

CONSISTENCY VS. METHODOLOGICAL RELEVANCE

The notion of methodological consistency of a method reflects the fact that the choice of impacts to be assessed is based on a methodological framework that must be respected; on the other hand, the notion of methodological relevance reflects the fact that the choice of impacts is made on an ad hoc basis, in order to assess only what is relevant. All the methods studied are based on a logic of methodological relevance.

[5] It should be noted, however, that monetisation is governed by the ISO 14008:2019 standard - Monetary valuation of environmental impacts and associated environmental aspects.

ENCOMPASSING CHARACTER VS. CONSCRIPT

The inclusive nature of a method reflects the fact that it seeks to consider a maximum number of actors affected by the object of study and thus to have a perspective of society as a whole. On the other hand, the conscripted character of a method means that it is limited to the perspective of one actor.

Methods with an inclusive character are CBA and LCSA. In contrast, the CSPI has a conscripted character, focusing on the impact of the organisation on the stakeholders directly affected by its activity (employees, consumers, etc.).

WEIGHTING OF PILLARS AND IMPACTS

In this context, weighting is an exercise aimed at attributing to each of the elements involved in the calculation of a result a weight proportional to its impact.

The methods for weighting the impacts are as follows:

- CBA does not provide for a dedicated weighting method but relies on the principle of intrinsic weighting of impacts by actors. The underlying assumption is that the monetary values that are used to quantify impacts already reflect their importance;
- The CSPI involves a dedicated weighting exercise of the indicators and then the pillars; the weighting method is described in more detail in section 2.

As for the LCSA, there are discrepancies between the methodological guides. The first work of formalising the LCSA does not provide for weighting. The methodology proposed by the ORIENTIGN project (cf. section "Reference systems" of the detailed report), provides for the integration of the results of the pillars.

INTEGRATION OF LCA

All the methods studied can integrate the results of an LCA.

- In CBA, the environmental pillar can be assessed via an LCA; the quantified impacts are monetised (all or only the most relevant ones) and compiled in the single result. Integration with LCA is, however, less easy than for LCSA due to the distinct levels of granularity (see paragraph on the object of study).
- In LCSA, LCA is recommended for the assessment of the environmental pillar.
- For the CSPI, some indicators of the environmental pillar could be quantified via an organisational LCA (see ISO/TS 14072:2014) such as CO_2 emissions, resource consumption, water consumption; however, other potential indicators such as hazardous waste generation or the percentage of green cover of the organisation's grounds will need to be quantified by other methods.

DIFFICULTY OF APPLICATION

An order of difficulty in applying the methods can be derived from the analysis presented in the table below. The method with the highest level of difficulty is the LCSA, followed by the CBA and then the CSPI.

Table 2 Analysis of key parameters that can influence the difficulty of carrying out an evaluation according to the methods (legend: in green the findings that can facilitate the application; in orange the findings that can make the application more difficult)

	CBA	LCSA	CSPI
LCA competence required [1]	No	Yes	No
Social LCA competence required [1]	No	Yes	No
Economic literacy required [1]	Yes	Yes	No
Availability of data via dedicated databases or internal sources [2].	Low	Average	Average
Particle size analysis [3].	Average	High	Low
Use of dedicated software [4].	Average	High	Low

[1] In terms of skills required, LCSA requires the mobilisation of a multidisciplinary team with skills in LCA, ASCV and economics. Depending on the complexity and purpose of the CBA assessments, LCA skills may be required but not necessarily. In general, the skill that will be required in CBA, given the need for monetary valuation, is expertise in economics. ICDV does not require expertise in LCA or economics.

[2] Searching for data is often a time-consuming, complex, and therefore costly task; the existence of dedicated databases or easy access to internal data (e.g., within the organisation) can reduce the cost/difficulty of the assessment. For methods such as LCA and SCA, which make up the LCSA, known and dedicated databases such as Ecoinvent and Pscilca are available. For CSPI, where the object of study is an organisation, internal data can be exploited, especially as they are already monitored and centralised. For CBA, data collection often must be done on an ad hoc basis and therefore the use of databases is more difficult.

[3] The level of detail of the analysis with regard to the individual assessment of the processes/actors involved in the production/manufacturing of the object of study (e.g., cost of household waste management vs. cost of collection, cost of transport, cost of intermediate storage, cost of incineration or landfill).

[4] This parameter is correlated with whether LCA is included in the assessment; indeed, LCA assessments often use dedicated LCA software (GABI, RangeLCA, OpenLCA, UMBERTO, etc.) more often than other methods, although this is not strictly necessary.

3.2 Analysis of key strengths and weaknesses

The following table summarises the main strengths and weaknesses of the methods.

Table 3 Summary of strengths and weaknesses

	Strengths	Weaknesses
ACB	■ Macro-analytical perspective more suitable for "go/no go" decisions on an investment project or public policy. ■ Maturity of the method, given the long history of its formalisation and the many cases of application. ■ Flexibility in the consideration of impacts by following a selection approach of relevant impacts. ■ Unique result.	■ Loose methodological framework that may hinder the replicability of results. ■ Medium compatibility with LCA. ■ Weak synergies with the SDGs. ■ Medium difficulty of application.
LCSA	■ Micro-analytical perspective more suited to an assessment approach for the identification of hotspots in the value chain of a given product with a view to optimising societal impacts. ■ Strong compatibility with LCA.	■ Less flexibility in the consideration of impacts by following an impact selection approach consistent with a metrological framework. ■ Less mature methodological framework. ■ Less mature methodological framework; lack of detailed guidance. ■ High difficulty of implementation due to the need for multi-disciplinary practitioners.
CSPI	■ Organisational perspective for the evaluation & monitoring of organisations in a sustainable development decision making process. ■ Flexibility in the consideration of impacts by following a selection approach of relevant impacts. ■ Strong synergies with the SDGs in case of selection of indicators consistent with those of the SDGs. ■ Unique result.	■ Loose methodological framework that may hinder the replicability of results. ■ Weak compatibility with LCA. ■ Less mature methodological framework. ■ Subjective weighting of impacts and pillars by following a rating of 1 to 5; this can lead to distortions in the weighting as such a rating allows a maximum weighting of factor 5 when the weighting could be much higher (factor 100, 1000 or even more).

4 Logigram

The following flowchart summarises the key issues that the practitioner should consider when choosing the appropriate method from among CBA, LCSA and CSPI.

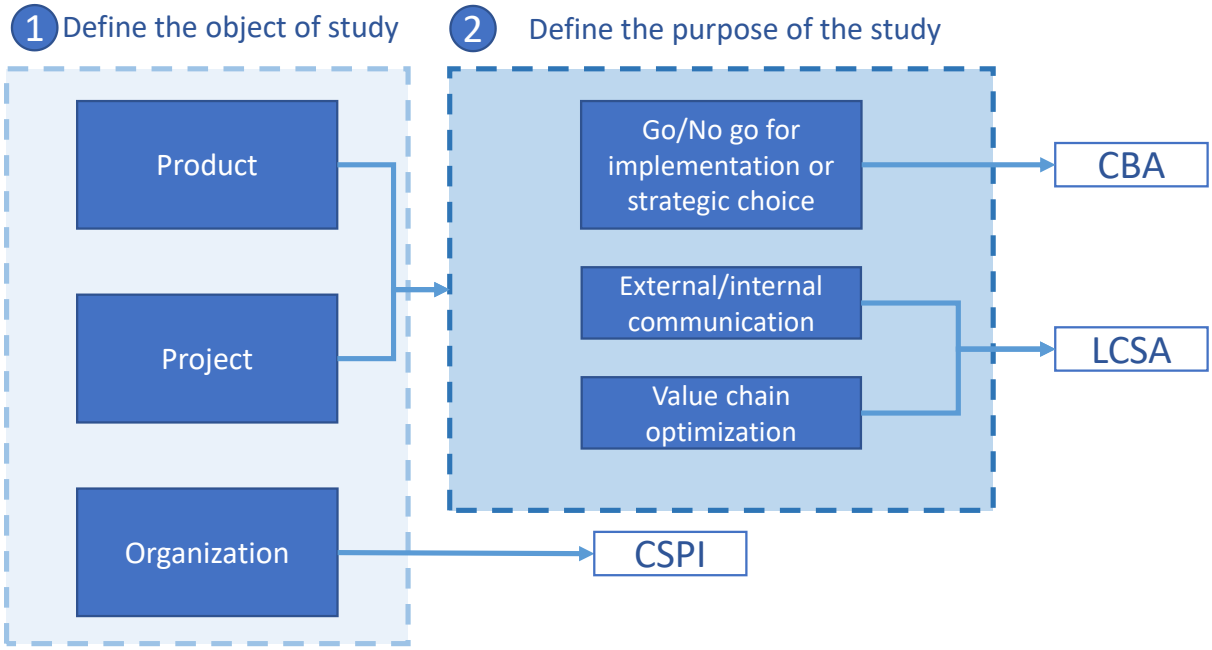

Figure 1 Flow chart to help choose between the three methods studied.

The practitioner must first establish what the object of study is. If the object of study is an organisation, the CSPI should be used. As a reminder, the CSPI seeks to assess the impact of the organisation's activities through economic, environmental and social indicators in order to integrate these performance indicators into their decision making and communicate them (externally and/or internally). If the object of study is a project or a product, then the practitioner should consider the objectives before choosing between CBA and LCSA. Indeed, the line between CBA and LCSA in terms of the object of study is less clear. Indeed, there is flexibility between these two methods; a CBA could be used to evaluate a product and an LCSA a project.

If the objective of the study is to reach a conclusion on whether to implement a project (e.g., a public policy) or to make a strategic choice between several options (between two product alternatives or between two public policy alternatives), CBA should be used. This is because CBA focuses more on the final societal effects that the object of study has on individuals in a society and pays less attention to processes, life cycle stages and the pillar-by-pillar detail of impacts. CBA provides a macro-analytical perspective which is therefore more suitable for this type of decision-making. If, on the other hand, the objective of the study is to identify hotspots in the value chain of a given product with a view to optimising societal impacts, the LCSA should be used. This method provides a micro-analytical perspective due to the higher resolution of process and life cycle stage assessments.

5 Methodological references

Methods may or may not be governed by a strict and binding frame of reference. Thus, the type of reference frameworks and the precise sources to which to refer in order to deepen certain aspects and/or apply the method in practice are indicated in section 5 of the detailed report.

EXPERTS ET SOLUTIONS EN DÉVELOPPEMENT DURABLE
rdcenvironment.be - contact@ rdcenvironment.be

Address

Av. Gustave Demey, 57

1160 Brussels, Belgium

Telephone

+32 2 420 28 23

Web Online

contact@rdcenvironment.be

www.rdcenvironment.be