INTERNATIONAL STANDARD

ISO 15686-6

First edition
2004-09-01

Buildings and constructed assets — Service life planning —

Part 6: Procedures for considering environmental impacts

Bâtiments et biens immobiliers construits — Prévision de la durée de vie —

Partie 6: Procédés pour la considération d'effets sur l'environnement

Reference number
ISO 15686-6:2004(E)

PDF disclaimer

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 15686-6 was prepared by Technical Committee ISO/TC 59, *Building construction*, Subcommittee SC 14, *Design life*.

It is closely related to standards in the ISO 14000 series (environmental management). While it does not conflict with these, it complements them by describing how environmental management standards, especially ISO 14040, may be implemented in the context of ISO 15686.

ISO 15686 consists of the following parts, under the general title *Buildings and constructed assets — Service life planning*:

— *Part 1: General principles*

— *Part 2: Service life prediction procedures*

— *Part 3: Performance audits and reviews*

— *Part 5: Whole life costing*

— *Part 6: Procedures for considering environmental impacts*

— *Part 7: Performance evaluation for feedback of service life data from existing construction works*

— *Part 8: Reference service life*

Part 4 is under preparation.

Introduction

Buildings and other constructed assets will require care from the initial proposal through to design, construction, operation, maintenance and disposal if they are to meet the required levels of performance. ISO 15686-1 and ISO 15686-2 explain the principles of service life planning (SLP) for different types of constructed assets, components and assemblies. This part of ISO 15686 defines how and when to include environmental aspects into the design of a constructed asset. It provides a procedure for assessing the relative environmental impacts of design options and it identifies the interface between environmental life cycle assessment (LCA) and SLP. The approach allows for consistent comparisons to be made between two or more design options taking the relevant factors from SLP into account.

The target audience for this part of ISO 15686 includes the client, design professionals and consultants, and the entire decision supply chain represented in the design team. It will also be relevant to stakeholders and specialists providing information on service life and on environmental impacts.

Buildings and constructed assets — Service life planning —

Part 6: Procedures for considering environmental impacts

1 Scope

This part of ISO 15686 describes how to assess, at the design stage, the potential environmental impacts of alternative designs of a constructed asset. It identifies the interface between environmental life cycle assessment and service life planning (SLP).

NOTE In order to illustrate the context of ISO 15686-6, other performance criteria are referred to, but they are not defined within its scope.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 6707-1, *Building and civil engineering — Vocabulary — Part 1: General terms*

ISO/TR 14025, *Environmental labels and declarations — Type III environmental declarations*

ISO 14040, *Environmental management — Life cycle assessment — Principles and framework*

3 Terms and definitions

For the purposes of this idocument, the terms and definitions given in ISO 6707-1, ISO/TR 14025, ISO 14040 and the following apply.

3.1
product
produce of the building sector, from materials through components, elements and systems to entire buildings and constructed assets

3.2
design option
one of several product alternatives that is a candidate for inclusion into the design, including functionality and service provided

3.3
design team
individuals involved in the decision-making process affecting the service life of the constructed asset

3.4
environmental aspect
element of an organization's activities or products or services that can interact with the environment

[ISO 14001:—, definition 3.5]

3.5
environmental impact
any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organization's environmental aspects

[ISO 14001:—, definition 3.6]

4 Description of the procedure for considering environmental impacts

4.1 General

Environmental impacts associated with constructed assets can be significant and should often be addressed in project planning. Every product has some impact on the environment. These impacts can occur at any or all phases of the product's life cycle and can be local, regional or global, or a combination of all three.

NOTE Improvements in one aspect of concern can lead to a reduction of performance in another field. This part of ISO 15686 does not give any recommendation concerning the balance between environmental and other aspects.

4.2 Integrating environmental assessment into SLP

The assessment of environmental impacts of a design option should in most practical cases be performed in parallel with technical and economic assessments. In general, these assessments have a common purpose: information about the product should be assessed in order to provide the decision maker, and other stakeholders, with comprehensive and reliable information about the product's performance. As constructed assets have long service lives, some of the underlying information should be drawn from the product application context and from scenarios concerning technical and economic performance, as well as user-related aspects. The assessment deals with predicted performance, and may not give the same result as a post-life retrospective performance evaluation. The purpose of SLP is to create a realistic picture of the predicted performance and to make such performance scenarios more accurate.

The early incorporation of internal and external interests, representing a broad sphere of bodies from stakeholders to the planning team, will assist in successfully addressing environmental aspects. This early involvement in the setting and communication of environmental goals as well as participation in the assessment procedure decreases the potential of a conflict of interests. Results of environmental assessment are intended to allow the design team to include environmental aspects into their decision making.

Comparing and assessing the relative environmental impacts of design options require detailed information about these options and the context of their application. Usually, LCA-based environmental information about construction products and their supply chain can be acquired for early life cycle phases of these products (see Figure 3). Direct comparisons of product or design alternatives should include information concerning use phase and end of life (see ISO/TR 14025 and ISO 21930). Consequently, for later life cycle phases (scenarios from current position to end of life), the assessor will have to complete the information by adding estimates for the processes in the other significant life cycle phases. The service life should be predicted on the basis of product performance as well as the expected application context, where relevant.

When integrating environmental assessment into SLP, the predicted service life of a design option should reflect the current application. The better the scenarios for service life, including maintenance and exposure to deterioration processes, reflect the current situation and the more they are based on information determined with reference to other parts of ISO 15686, the more accurate the assessment will be.

4.3 Positioning in project planning and the life cycle

The exercise of SLP and environmental assessment may occur prior to, or during, any phase in the life cycle of a constructed asset.

The client's brief as well as building regulations have significant influence on the formulation of the initial concept for the project. Goals identified in regulations and the client's brief, paired with goals in the management routines of the parties represented in the project team can be translated into performance requirements. In relation to these requirements, a technical, economic and environmental assessment should be carried out, as indicated in Figure 1. Depending on the degree to which a design option fulfils the performance requirements, the project team can make the decision whether or not to include a design option. Again, the level of detail of an assessment and the character of the underlying information depend on the current phase in project planning. Early in the planning process, as in the initial design stage, the information will be less accurate and more general and directional. Later, in detailed design, many decisions concerning the constructed asset have already been made and the assessment can be made in more detail. Meanwhile, the earlier the design team considers environmental matters, the easier it will be to identify design solutions that meet identified requirements. Decisions, as well as underlying information, should be well documented and ultimately be included in the project documentation.

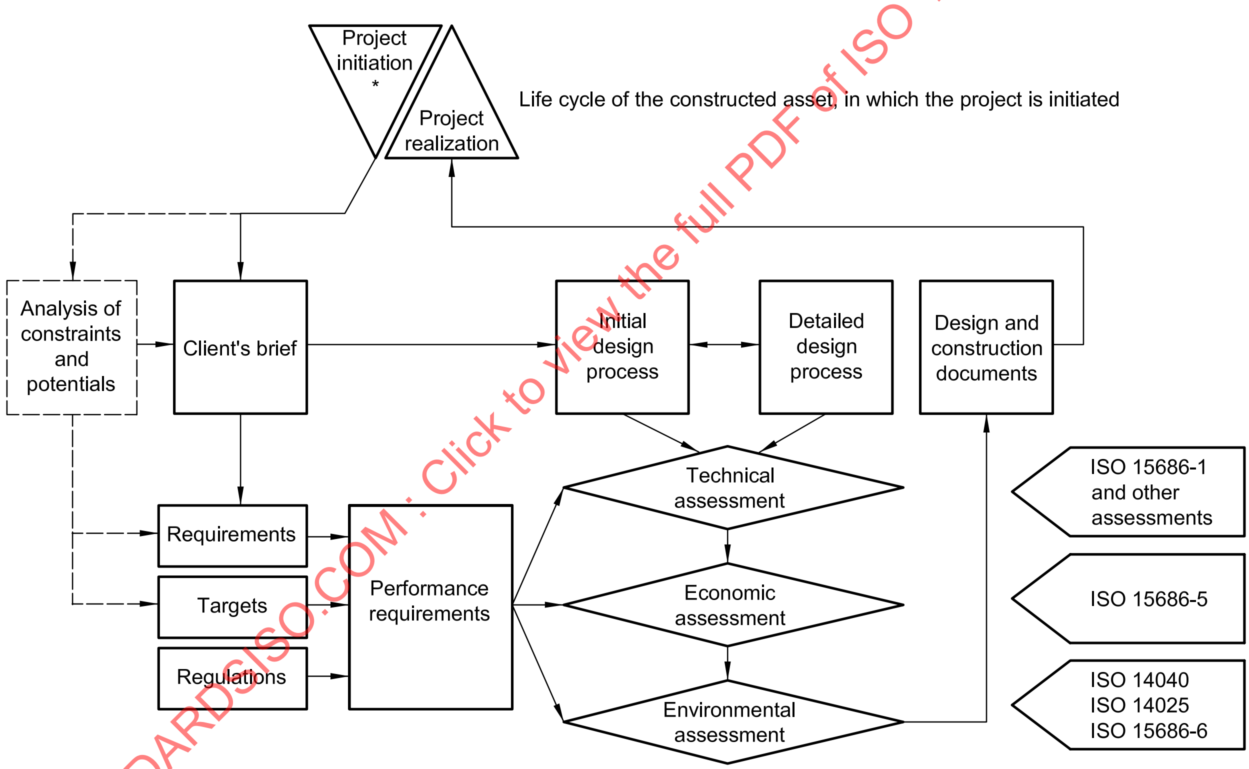

Figure 1 — Technical, economic and environmental assessment in SLP and the location of project planning in the life cycle of the building/constructed asset

4.4 Design options and functional equivalency

When there are options available to fulfil a requirement, the goal is to enable the decision maker to make a tentative decision and to implement the option that best meets the requirements.

NOTE 1 Identification of design options is not considered in this part of ISO 15686.

In order to make meaningful comparisons of options, their functional equivalency should be determined. When that equivalency has been established, the decision should be based on criteria such as initial cost, whole life cost and environmental impacts, or a combination of these. In this context, some criteria may be assigned greater importance than others.

Fitness for purpose should be included in the technical assessment. To make a meaningful environmental comparison between two design options, they should be equivalent in their fitness for purpose and other technical criteria. Economic criteria may not necessarily be equivalent.

NOTE 2 It is not within the scope of this part of ISO 15686 to advise on methods to determine functional equivalency, nor to advise on the balance between various aspects of performance.

LCA methodology requires comparative assessments to be based on a common “functional unit”. For LCA in SLP, the functional unit should correspond to the identified performance requirements. This means that the functional equivalency should comprise aspects of performance of the options as well as of the constructed asset, where relevant (see Figure 2).

After identifying functionally equivalent options, environmental information for these options should be gathered and assessed. As the design team is not necessarily a team of LCA practitioners, they may rely on external sources for LCA data. In general, the designer of the constructed asset has little influence on the production processes for the product options. Therefore, the decision is related to the product “as is” and to the product as it performs in the intended application. The decision is restricted to either accept or reject the options.

Acceptance of a design option should be based on assessment criteria that are anchored in the performance requirements (see Figure 1, Figure 2 and 4.5).

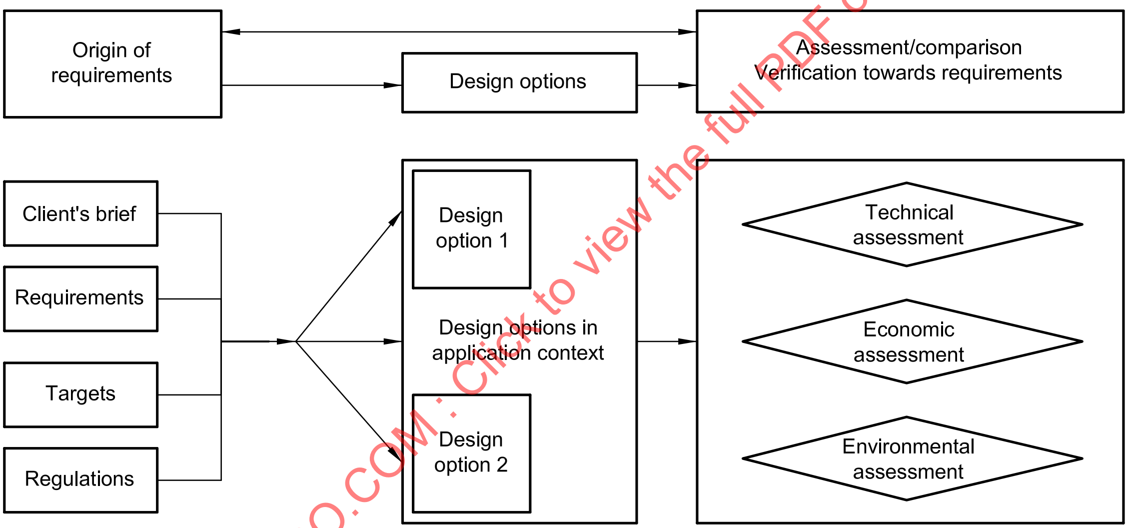

Figure 2 — Assessment of product in context: performance criteria

NOTE 3 With the growing number of LCA tools and the growth in the LCA data available for the construction sector, this part of ISO 15686 recognizes and refers to standards in the ISO 14040 series and to non-ISO documents in which LCA methodology issues are discussed (such as the SETAC Report [9]).

4.5 Origin and verification of requirements and references

For simplifying purposes, a product qualifies for integration into the current design if it meets the established performance requirements. These can have various origins, some of which are listed as follows.

a) Decision-making context:

1) client's brief: the client specifies the requirements for the project;

2) regulation: requirements from national and local governmental bodies;

3) management routines in the project team: the project team acts according to its own principles, directly and indirectly influencing the client and the client's brief;

4) client consultants: assisting the client in such matters as specifying the product, and assisting in choice of the project team.

b) Context of constructed asset:

1) building context: the kind of project, point in the life cycle, site-specific considerations, integration in infrastructure;

2) performance aspects of the constructed asset;

3) physical attributes of the site.

Together, these influences will be reflected in an initial document that takes up the essential requirements from the various backgrounds. In order to establish reasonable requirements that reflect the current preconditions, an investigation into project constraints and opportunities should be carried out. Similar to a screening assessment, items of special project-related emphasis should be identified.

To achieve the specified environmental quality a three-step procedure should be followed. Requirements regarding environmental impact may be expressed in terms of

— use of materials,

— use of energy,

— use of water,

— emission of substances, including hazardous and toxic emissions, and

— use of land and impact on biodiversity.

NOTE The origin of these requirements can be, for example, the client's interest, regulation, or goals from environmental management systems (see Figure 1). Depending on the specification of requirements, it may be necessary to apply assessment methodologies other than LCA.

4.6 LCA and environmental impact

In general, products cause environmental impacts through the inputs to and outputs from all processes associated with their life cycles. Inputs are the materials and energy; outputs include the product(s) produced, air emissions, water effluents, waste materials and any other releases. In addition to their impact on the external environment, constructed assets may provide an internal environment for human activity. The quality of the constructed environment provided for people and its impacts upon health, comfort, well-being and productivity are also important, although possibly more difficult to address, and cannot be addressed by LCA.

LCA is a technique for assessing the environmental aspects and potential impacts associated with a product, by

a) compiling an inventory of relevant inputs and outputs of a system,

b) evaluating the potential environmental impacts associated with those inputs and outputs, and

c) interpreting the results of the inventory and impact phases in relation to the objectives of the study.

NOTE 1 LCA is standardized in ISO 14040, ISO 14041, ISO 14042 and ISO 14043.

If results from different LCA studies are to be compared or combined with each other, it is essential that these LCA studies be consistent. Differences in methodology, scenario definitions, system boundaries, underlying data, allocation models, etc., will undermine any comparative results.

Applying LCA results for comparative assessments has numerous underlying requirements (see ISO 14040). The most important requirement is that decision makers in the design team implementing LCA should be aware of the appropriateness of the adopted LCA data; this means that they should have access to the underlying studies and have the expertise needed to analyse and correctly interpret the information.

When implementing LCA in SLP, it is anticipated that, in most situations, the LCA will not be performed within the procedure. Therefore the above requirement can seldom be met in practice. Rather, existing data sets should be considered and combined in order to model the current design option. To allow this kind of approach, it is a precondition that the applied LCA data sets are following an LCA routine that is conforming to the ISO 14040 series, and that it is harmonized further than the requirements of these standards. To allow the application of LCA-based information in the context of SLP, information is required to meet requirements following a harmonized programme conforming to ISO/TR 14025 or sector-specific requirements conforming to, for example, ISO 21930.

NOTE 2 Harmonized specification of requirements for LCA-based information can result in sector-specific or product-specific requirements (PSRs). Such PSRs are underlying national or sector-specific programs for the establishment of, for example, environmental product declarations conforming to ISO/TR 14025 or ISO 21930. These contain requirements for LCA-based information drawn specifically for product categories, resulting in program instructions for environmental declaration. Environmental information on construction products that is made available to design teams may be established based on such PSRs. The decision maker can rely on the validity and quality of the supplied information providing that conformity with PSRs is assured.

4.7 Considering service life in LCA

LCA should concern the entire life cycle of the assessed product. Therefore, the use phase should be included. For construction products and constructed assets, the use phase is usually long. Further differences between considered design options can also concern the service life duration. For that reason, the displayed LCA results can be significantly dependent on scenarios and assumptions concerning the duration and the processes involved in the use phase. To establish realistic scenarios that reflect the current preconditions, these scenarios should incorporate information that can be obtained from the SLP process, namely the estimated service life (ESL) and use, exposure and maintenance assumptions.

4.8 Life cycle phases and data sources

4.8.1 General

4.8.1.1 Environmental impacts commonly arise from activities that take place during the life cycle of the constructed asset, such as

a) raw material extraction,

b) product manufacturing,

c) asset construction,

d) use and maintenance, and

e) end of life.

Depending on the scope of concern, the environmental impact caused during these life cycle phases, as well as those caused due to the use of services during the life cycle (e.g. transportation), should be included.

Life cycle phases and their relationship to data sources and the process of SLP are shown in Figure 3, which illustrates the link between LCA data and SLP. The dotted line represents the distinction between life cycle phases: for phases above the dotted line, actual data can be collected, for phases below the line, data should be calculated at least in part from scenarios.

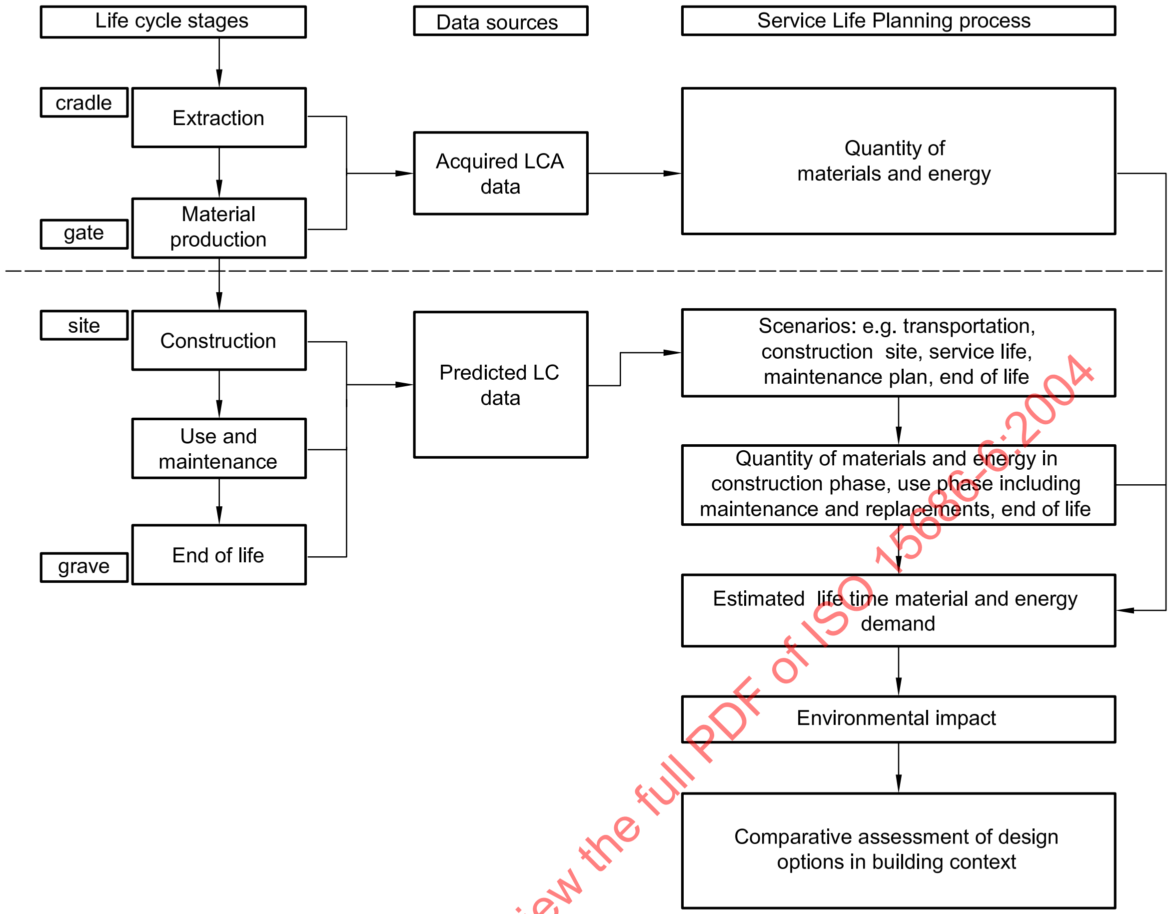

Figure 3 — Life cycle phases, data sources and SLP process

4.8.1.2 When considering the application of LCA data and the inclusion of the entire life cycle, the following sources should be consulted.

a) Data about the extraction of raw materials, the manufacture of products and the combustion of fuels can be obtained from databases or directly from manufacturers. When available from manufacturers, this will commonly be in the form of environmental declarations, as identified in ISO/TR 14025.

b) Information about frequency of use, maintenance and replacement, as well as end of life, is generated in the SLP process. Service life data are based on the experience of the design team, information from manufacturers, and/or modelling. The environmental impact data for activities such as maintenance can be acquired from standard databases, product manufacturers and maintenance companies.

c) LCA data often include a complete "cradle to grave" scenario. To ensure that the LCA data are suitable for the particular situation in project planning, it is essential to obtain data that allow the specific use, maintenance and end of life scenarios to be considered.

NOTE Data about construction products can take the form of environmental declarations, environmental profiles, LCA databases, etc.

Two types of LCA data can be distinguished as described in 4.8.2 and 4.8.3.

4.8.2 Acquired LCA data

For past life cycle phases of a product, LCA data can be acquired from different sources. In general terms of LCA application in SLP, this will be the "cradle to gate" data (see Figure 3).

4.8.3 Predicted/scenario-based LCA data

Environmental impacts that are predicted to occur in the remaining life cycle phases (from installation on site through to end of life) are presented as predicted data. Such data concern processes that are likely to occur in the future. Accurate data that cannot be found in records should be generated based on scenarios.

For the inclusion of LCA data into SLP, it is recommended that, at least initially, acquired and predicted LCA data be kept separate. Where LCA data are kept separate, the scenarios may be analysed more easily and, if necessary, adapted or replaced.

5 Interpretation of comparative assessment

In order to support the decision-making process, the assessment result should be described within the context of the performance requirements that have been identified for the project. The ability of the decision maker to interpret environmental information will determine whether the results of the environmental assessment are left in a more complex state, or whether interpretation techniques such as weighting may be applied, with the results being aggregated until they enable a decision to be made.

6 Decision making and documentation

The decision maker should identify one or more design options that either

— meet the set requirements concerning technical, economic and environmental performance, or

— show relative preferability in the fields of concern.

The final decision on the detailed design should be based on the information for the SLP process gained from other parts of ISO 15686 and from external sources, such as LCA databases.

The simplified flow chart in Figure 4 gives a general identification of the main steps in the decision-making process. The identified steps are illustrated with some core points for consideration. For each project, these should be adapted and developed in order to ensure that the demands of the project are met.

Clear documentation and reporting of the considered environmental aspects are necessary to verify that the requirements have been addressed, including those concerning the following:

a) definition of the subject of assessment: inclusion of life cycle stages and processes;

b) consideration of environmental impacts: inclusion or exclusion of fields of environmental concern.

The outcome is the presentation of environmental data for a design option. In a comparison, environmental assessment data should be displayed for identical parameters and measured on an equivalent basis. An environmental preference for an option should be made on the basis of this comparison.

The result of the environmental assessment should be displayed in terms of one or a set of environmental parameter(s) that can be included in the decision-making process. Selected parts of the environmental assessment data may also be considered as input to an assessment of cost externalities, as part of the application of whole-life-costing models, as established in ISO 15686-5.