INTERNATIONAL STANDARD

ISO 21931-2

First edition
2019-05

Sustainability in buildings and civil engineering works — Framework for methods of assessment of the environmental, social and economic performance of construction works as a basis for sustainability assessment —

Part 2: Civil engineering works

Développement durable dans la construction — Cadre méthodologique de l'évaluation au sens du développement durable des performances environnementales, sociales et économiques des ouvrages de construction —

Partie 2: Ouvrages de génie civil

Reference number
ISO 21931-2:2019(E)

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 59, *Buildings and civil engineering works,* Subcommittee SC 17, *Sustainability in buildings and civil engineering works.*

A list of all parts in the ISO 21931 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

It is important to measure and understand the sustainability performance of civil engineering works in order to assess, communicate and improve their potential impacts on sustainable development.

This document establishes a framework for methods of assessment of the sustainability performance of civil engineering works and related external works, which is a central part of the process. The sustainability performance assessment evaluates aspects and impacts to assess the environmental, social and economic performance of civil engineering works using qualitative and quantitative indicators measured without value judgements. One of the primary purposes of this document is to improve the quality of the methods of assessment, which can enable greater comparability of the results of assessments. Such assessments can be used for benchmarking performance and monitoring progress towards improvement of performance.

Although there are not as many assessment methods for civil engineering works as there are for buildings, some can be found. The existence of these methods indicates a trend towards construction that contributes to sustainable development, whose main objectives are to minimize negative impacts and maximize positive direct and indirect impacts on sustainability, especially through a focus on

— use of resources (materials, water and energy) and waste generation,

— discharges into water, atmosphere and soil,

— biodiversity and ecosystems,

— social impacts, throughout the value chain, and

— innovative and proactive approach towards selecting the most beneficial and economical alternatives.

Methods of assessment of the sustainability performance of civil engineering works provide a basis for demonstrating and communicating the result of efforts to improve sustainability performance in construction works. The methods typically establish a means of assessing a broad range of considerations related to sustainability against explicitly declared criteria, and give a summary of sustainability performance.

Methods of assessment of the sustainability performance of civil engineering works provide:

— a common and verifiable set of references, so that civil engineering works owners, striving for increasing their beneficial contribution to sustainable development, have a means of measuring, evaluating and demonstrating that effort;

— a reference for use as a common basis, by which the civil engineering works owners/managers, design teams, contractors and suppliers can formulate effective strategies regarding the design, construction and operation of civil engineering works, with the intent to improve sustainability performance;

— detailed information on the civil engineering works gathered and organized in such a way that it can be used to lower operating, financing and insurance costs and increase operating efficiency and life;

— a clear description of the factors considered to be the key sustainable considerations and their relative importance, thereby assisting the design process.

To achieve the practical goals noted above, methods of assessment of the sustainability performance of civil engineering works refer to limited criteria and seek a balance between rigor and practicality. The sustainability performance assessment of civil engineering works uses different types of information. The results of a sustainability performance assessment of a civil engineering works provide information on the different types of indicators, the related civil engineering works scenarios and the life cycle stages included in the assessment. Life-cycle based approaches play an increasingly significant role for setting performance criteria within methods of assessment of sustainability performance of civil engineering works. In carrying out assessments, scenarios and a functional equivalent are determined

at the civil engineering works level. Assessment at the civil engineering works level means that the descriptive model of the works, along with the major technical and functional requirements, has been defined in the client's brief or in the regulations.

However, the collection and maintenance of current data sets for the multitude of civil engineering works systems and elements may not be practically achievable at the moment. Also, the context of overall civil engineering works performance is important for considering each sustainable criterion.

Considering all these issues, the purpose of this document is to describe the framework and the principles that apply in the sustainability performance assessment of new and existing civil engineering works and their related site works, taking into account the various effects these civil engineering works are likely to have.

Practical relevant rules and recommendations concerning methods for the assessment of the sustainability performance of civil engineering works, which can exist on either a national or regional basis, can be examined and improved by the use of a framework for methods of assessment, which is the basis of this document.

An improvement of the sustainability performance of a civil engineering works requires an appropriate operation of the civil engineering works over its lifetime. In existing civil engineering works, it can be enhanced through the use of "sustainability-related" policies and the implementation of management systems.

This document is one in a suite of documents dealing with sustainability in construction works that includes the following:

a) ISO 15392, *Sustainability in buildings and civil engineering works — General principles*;

b) ISO 16745-1, *Sustainability in buildings and civil engineering works — Carbon metric of an existing building during use stage — Part 1: Calculation, reporting and communication*;

c) ISO 16745-2, *Sustainability in buildings and civil engineering works — Carbon metric of an existing building during use stage — Part 2: Verification*;

d) ISO 20887, *Sustainability in buildings and civil engineering works — Design for disassembly and adaptability of buildings*;

e) ISO 21929-1, *Sustainability in building construction — Sustainability indicators — Part 1: Framework for the development of indicators and a core set of indicators for buildings*;

f) ISO/TS 21929-2, *Sustainability in building construction — Sustainability indicators — Part 2: Framework for the development of indicators for civil engineering works*;

g) ISO 21930, *Sustainability in buildings and civil engineering works — Core rules for environmental product declarations of construction products and services*;

h) ISO 21931-1, *Sustainability in buildings and civil engineering works — Framework for methods of assessment of the environmental, social and economic performance of construction works as a basis for sustainability assessment — Part 1: Buildings*;

i) ISO 21931-2, *Sustainability in buildings and civil engineering works — Framework for methods of assessment of the environmental, social and economic performance of construction works as a basis for sustainability assessment — Part 2: Civil engineering works*;

j) ISO/TS 12720, *Sustainability in buildings and civil engineering works — Guidelines on the application of the general principles in ISO 15392*;

k) ISO/TR 21932, *Sustainability in buildings and civil engineering works — A review of terminology*.

The relationship among the documents is elaborated in Figure 1.

It should be noted that due to the wide range of different types and scale of civil engineering works it is not practical to include a single core set of indicators within this document. As a result there is a suite of inter-related standards that define the process of assessing the sustainability performance of civil engineering works that includes ISO/TS 21929-2, this document and a future standardization work on systems of indicators for different civil engineering work typologies.

As a suite, they define a methodology that combines rigour, consistence and flexibility in the assessment of a wide range of civil engineering works.

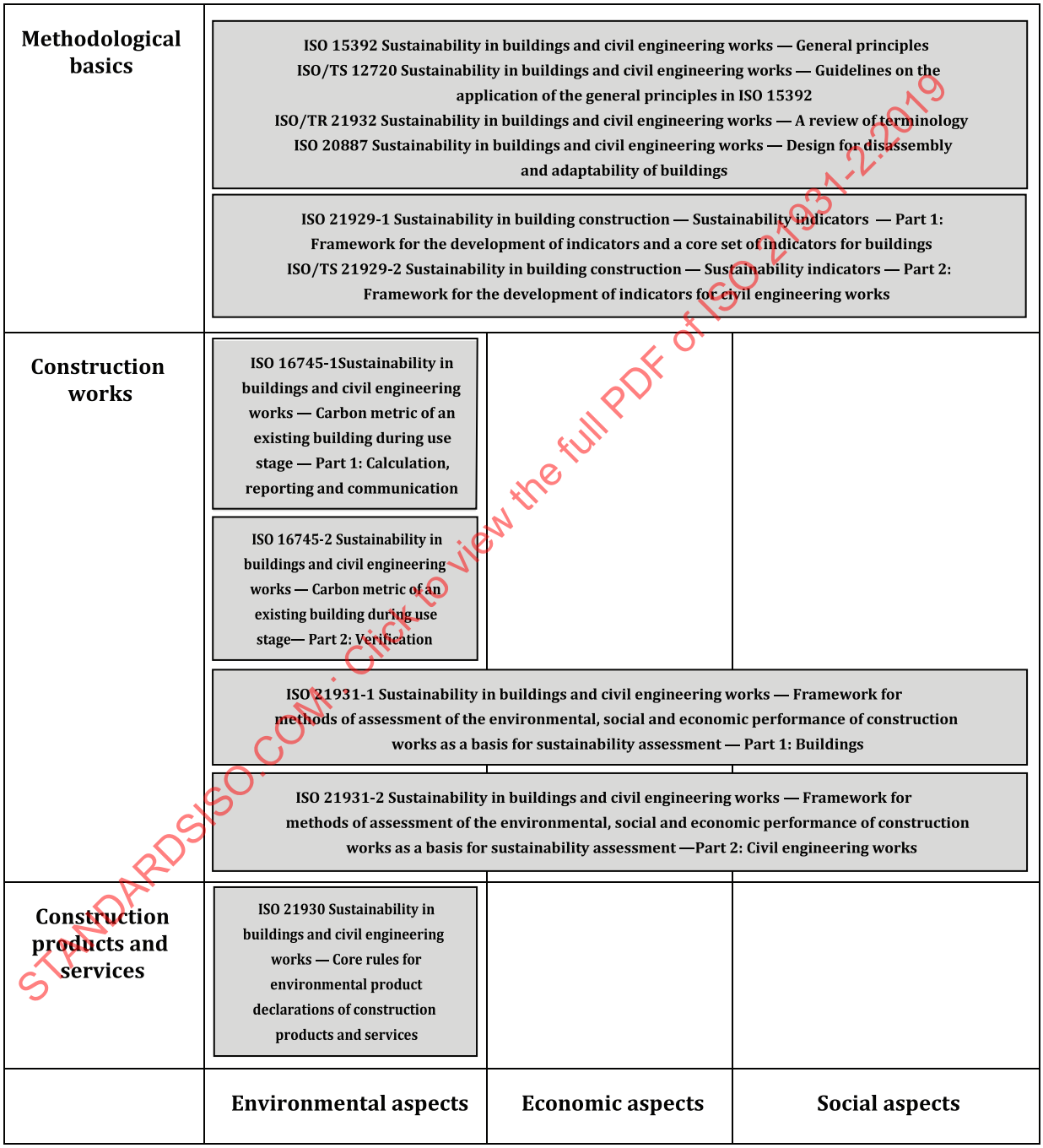

Figure 1 — Suite of related documents for sustainability in buildings and civil engineering works

Sustainability in buildings and civil engineering works — Framework for methods of assessment of the environmental, social and economic performance of construction works as a basis for sustainability assessment —

Part 2: Civil engineering works

1 Scope

This document provides a general framework for improving the quality and comparability of methods for assessing the contribution of civil engineering works and their related external works to sustainable development based on a life cycle approach.

This document aims to bridge the gap between regional and national methods for the assessment of the sustainability performance of civil engineering works by providing a common framework for their expression.

This document identifies and describes issues to be taken into account in the development and use of methods for the assessment of the sustainability performance for all types of civil engineering works, both new and existing, and it is relevant for the assessment of the environmental, social and economic performance of both new and existing civil engineering works over their entire life cycle.

The object of assessment in this document is the civil engineering works itself and its area of influence.

NOTE 1 For example, the assessment includes any local civil engineering works beyond the immediate area of the civil engineering works; the transportation of the users of the civil engineering works; and the use and exploitation of the civil engineering works itself.

Assessments can be undertaken either for the whole civil engineering works, for a part of the civil engineering works, or for a combination of several civil engineering works.

This document excludes environmental, social and economic risk assessment, but the results of a risk assessment can be taken into consideration.

This document is intended to be used in conjunction with, and following the principles set out in, ISO 15392 and the ISO 14000 family of International Standards.

The evaluation of technical and functional performance of the civil engineering works is outside the scope of this document, but the technical and functional characteristics are considered within this framework by reference to the functional equivalent. The functional equivalent takes into account the technical and functional requirements and forms the basis for comparisons of the results of the assessment.

Assessment methods that consider only one or two of the three dimensions of sustainability are outside the scope of this document.

This document does not set benchmarks or levels of performance relative to environmental, social and economic aspects and impacts.

NOTE 2 Valuation methods, levels, classes or benchmarks can be prescribed in the requirements for environmental, social and economic performance in the client's brief, construction regulations, national standards, national codes of practice, civil engineering works assessment and certification schemes, etc.

The rules for methods of assessment to consider in the assessment of environmental, social and economic aspects of operation practices are included within this framework, and the consequences of decisions or actions that influence the environmental, social and economic performance of the object of assessment are identified so that they can be taken into account.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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, *Buildings and civil engineering works — Vocabulary — Part 1: General terms*

ISO 14025:2006, *Environmental labels and declarations — Type III environmental declarations — Principles and procedures*

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

ISO 14044, *Environmental management — Life cycle assessment — Requirements and guidelines*

ISO 14050, *Environmental management — Vocabulary*

ISO 15686-1, *Buildings and constructed assets — Service life planning — Part 1: General principles and framework*

ISO 15686-2, *Buildings and constructed assets — Service life planning — Part 2: Service life prediction procedures*

ISO 15686-7, *Buildings and constructed assets — Service life planning — Part 7: Performance evaluation for feedback of service life data from practice*

ISO 15686-8, *Buildings and constructed assets — Service-life planning — Part 8: Reference service life and service-life estimation*

ISO/TS 15686-9, *Buildings and constructed assets — Service-life planning — Part 9: Guidance on assessment of service-life data*

ISO 21930, *Sustainability in buildings and civil engineering works — Core rules for environmental product declarations of construction products and services*

ISO/TR 21932, *Sustainability in buildings and civil engineering works — A review of terminology*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 6707-1, ISO 14050, ISO/TR 21932 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
accessibility
ability for users to access the service(s) that the *civil engineering works* (3.5) is providing and/or to access nature

Note 1 to entry: Examples of services that can be provided include water or energy supply and mobility service.

3.2
area of influence
area or combination of areas surrounding a *civil engineering works* (3.5) that can be affected with changes to their economical, environmental or social conditions by the civil engineering works' operations throughout its *life cycle* (3.18)

Note 1 to entry: The area of influence is variable and dependent on the *construction works* (3.8) *project* (3.22), its location and its life cycle stage. As an overall approach, the area of influence is usually limited to the civil engineering works itself and its immediate surroundings.

[SOURCE: ISO/TS 21929-2:2015, 3.2]

3.3
avoided impact
benefits and loads that occur as a result of combining functions and thereby avoid the need for additional (i.e. separate) *civil engineering works* (3.5)

Note 1 to entry: Avoided impacts can be positive or negative.

3.4
brief
program, US
document that states the requirements for a *project* (3.22)

[SOURCE: ISO 6707-2:2017, 3.2.18]

3.5
civil engineering works
civil engineering project, US
construction works (3.8) comprising a structure, such as a dam, bridge, road, railway, runway, utilities, pipeline, or sewerage system, or the result of operations such as dredging, earthwork, geotechnical *processes* (3.21), but excluding a building and its associated site works

[SOURCE: ISO 6707-1:2017, 3.1.1.2, modified — The alternative term "civil engineering project, US" has been deleted; Note 1 to entry has been deleted.]

3.6
client
person or organization initiating and financing a *project* (3.22) and approving the *brief* (3.4)

[SOURCE: ISO 6707-2:2017, 3.8.2]

3.7
construction product
item manufactured or processed for incorporation in a *civil engineering works* (3.5)

Note 1 to entry: Construction products are items supplied by a single responsible body.

Note 2 to entry: In this document, unless otherwise designated, the term construction product is used for any good(s) or service(s) related to civil engineering works.

Note 3 to entry: Construction assemblies, construction elements and integrated technical systems, incorporated within a civil engineering works, can be considered construction products.

[SOURCE: ISO 21930:2017, 3.2.2, modified — The wording "construction works" has been replaced with "civil engineering works".]

3.8
construction works
construction, US
everything that is constructed or results from construction operations

Note 1 to entry: Construction works covers all buildings and *civil engineering works* (3.5).

[SOURCE: ISO 6707-1:2017, 3.1.1.1, modified — Original Note 1 to entry has been deleted; new Note 1 to entry has been added.]

3.9
downstream process
process (3.21) that is carried out after the designated process in the stream of relevant processes

[SOURCE: ISO 21931-1:2010, 3.2]

3.10
economic aspect
aspect of *civil engineering works* (3.5), part of civil engineering works, *processes* (3.21) or services related to their *life cycle* (3.18) that can cause a change to economic conditions

[SOURCE: ISO 15392:—, 3.11, modified — The wordings "constuction works" and "works" have been replaced with "civil engineering works".]

3.11
economic impact
change to the economy, adverse or beneficial, wholly or partially resulting from *economic aspects* (3.10)

[SOURCE: ISO 15392:—, 3.16.1, modified — The word "impact" has been replaced with "change"; "adverse or beneficial" has been added.]

3.12
economic performance
performance (3.20) of a *civil engineering works* (3.5) related to its *economic impacts* (3.11) and *economic aspects* (3.10)

3.13
environmental aspect
aspect of *civil engineering works* (3.5), part of civil engineering works, *processes* (3.21) or services related to their *life cycle* (3.18) that can cause a change to the environment

[SOURCE: ISO 15392:—, 3.12, modified — The wordings "constuction works" and "works" have been replaced with "civil engineering works".]

3.14
environmental impact
change to the environment, adverse or beneficial, wholly or partially resulting from *environmental aspects* (3.13)

[SOURCE: ISO 15392:—, 3.16.2, modified — The word "impact" has been replaced with "change"; "adverse or beneficial" has been added.]

3.15
environmental performance
performance (3.20) of a *civil engineering works* (3.5) related to its *environmental impacts* (3.14) and *environmental aspects* (3.13)

Note 1 to entry: The environmental performance is influenced by all *processes* (3.21) related to the *life cycle* (3.18) of the civil engineering works.

Note 2 to entry: Environmental performance can be expressed either quantitatively or qualitatively with reference to performance requirements or possibly relative to a scale of values or a benchmark.

[SOURCE: ISO 21931-1:2010, 3.5, modified — The word “building” has been replaced with “civil engineering works”.]

3.16
functional equivalent
quantified functional requirements and/or technical requirements for a *civil engineering works* (3.5) or construction (part of works) for use as a basis for comparison

[SOURCE: ISO 21931-1:2010, 3.7, modified — The word “building” has been replaced with “civil engineering works or construction (part of works)”; the word “reference” has been deleted.]

3.17
gate
point at which the *construction product* (3.7) or material leaves the factory before it becomes an input into another manufacturing *process* (3.21) or before it goes to the distributor, a factory or a construction site

[SOURCE: ISO 21930:2017, 3.3.8, modified — The wording “a subsequent manufacturing process” has been replaced with “another manufacturing process”; the wording “before it is transported to” has been replaced with “before it goes to”; the wording “another factory” has been replaced with “a factory”.]

3.18
life cycle
all consecutive and interlinked stages in the life of the object under consideration

Note 1 to entry: For consideration of *environmental impacts* (3.14) and *environmental aspects* (3.13), the life cycle comprises all stages, from raw material acquisition or generation from natural resources to end-of-life.

Note 2 to entry: Adapted from the definition of “life cycle” in ISO 14040:2006, 3.1.

[SOURCE: ISO 21930:2017, 3.3.1]

3.19
non-renewable resource
resource that exists in a fixed amount that cannot be naturally replenished or cleansed on a human time scale

Note 1 to entry: Activities that occur in the technosphere such as recycling are not considered natural replenishment or cleansing.

Note 2 to entry: In this context, human time scale refers to the typical life time of a human rather than the time humans have been in existence.

[SOURCE: ISO 21930:2017, 3.6.3, modified — Note 3 to entry has been deleted.]

3.20
performance
observed or predicted in use behaviour of a *civil engineering works* (3.5) to fulfil required functions under intended use conditions

Note 1 to entry: Behaviour in this context pertains to functional and technical requirements in use.

[SOURCE: ISO 15392:—, 3.19, modified — The wording “construction product or construction service” has been replaced with “civil engineering works”; the original Note 1 to entry has been deleted; a new Note 1 to entry has been added.]

3.21
process
series of operations performed to achieve a desired result

[SOURCE: ISO 21931-1:2010, 3.11]

3.22
project
unique *process* (3.21), consisting of a set of coordinated and controlled activities undertaken to achieve an objective

[SOURCE: ISO 6707-1:2017, 3.5.2.4]

3.23
reference study period
period of time over which the relevant aspects and impacts of the *civil engineering works* (3.5) are analyzed

Note 1 to entry: The reference study period is determined by the *client* (3.6).

3.24
renewable resource
resource that is grown, naturally replenished or cleansed on a human time scale

EXAMPLE Trees in forests, grasses in grasslands and fertile soil, wind.

Note 1 to entry: A renewable resource is capable of being exhausted but can last indefinitely with proper stewardship.

Note 2 to entry: Activities that occur in the technosphere such as recycling are not considered natural replenishment or cleansing.

Note 3 to entry: In this context, human time scale refers to the typical life time of a human rather than the time humans have been in existence.

[SOURCE: ISO 21930:2017, 3.6.2]

3.25
service life
period of time after installation during which a *civil engineering works* (3.5) or its component parts meet or exceed the *performance* (3.20) requirements

[SOURCE: ISO 6707-1:2017, 3.7.3.84, modified — The word "facility" has been replaced with "civil engineering works".]

3.26
social aspect
characteristic of *civil engineering works* (3.5), parts of civil engineering works, *processes* (3.21) or services related to their *life cycle* (3.18) that can cause a change to society or quality of life

[SOURCE: ISO 15392:—, 3.13, modified — The wordings "constuction works" and "works" have been replaced with "civil engineering works".]

3.27
social impact
change to society or quality of life, adverse or beneficial, wholly or partially resulting from *social aspects* (3.26)

[SOURCE: ISO 15392:—, 3.16.3, modified — The word "impact" has been replaced with "change"; "adverse or beneficial" has been added.]

3.28
social performance
performance (3.20) of a *civil engineering works* (3.5) related to its *social impacts* (3.27) and *social aspects* (3.26)

3.29
stakeholder
interested party
person or organization that can affect, be affected by, or perceive itself to be affected by a decision or activity

EXAMPLE Customers, communities, suppliers, regulators, non-governmental organizations, investors and employees.

[SOURCE: ISO 15392:—, 3.22]

3.30
sustainability performance
combination of *environmental performance* (3.15), *social performance* (3.28) and *economic performance* (3.12) of a *civil engineering works* (3.5)

3.31
system boundary
boundary representing physical, *process* (3.21), temporal and geographical limits of what is included and what is not included in an assessment

3.32
traceability
ability to trace the history, application or location of what is under consideration

[SOURCE: ISO 9000:2015, 3.6.13, modified — The wording "an object" has been replaced with "what is under consideration"; Notes 1 and 2 to entry have been deleted.]

3.33
transparency
open, comprehensive and understandable presentation of information

[SOURCE: ISO 14040:2006, 3.7]

3.34
upstream processes
process (3.21) carried out before the designated process in the stream of relevant processes

[SOURCE: ISO 21931-1:2010, 3.15]

4 Principles for the sustainability performance assessment of civil engineering works

This clause deals with the principles that are important for the application of this document in regards to the sustainability performance assessment of civil engineering works.

This document provides a system for the assessment of environmental, social and economic performance of civil engineering works based on a life cycle approach.

The assessment methods shall be credible, transparent and systematic in order to achieve traceability, transparency and comparability in the results of the assessment.

NOTE 1 The requirements for reporting and communication of the assessment results are given in 5.11.

The assessment methods for environmental, social and economic performance of civil engineering works developed under this framework take into account performance aspects and impacts that can be expressed with quantitative and qualitative indicators, which are measured without value judgements, leading to a clear result for each indicator.

Methodologies for the assessment of the sustainability performance of civil engineering works shall explicitly define the methods used to take account of the aspects and impacts of the civil engineering works.

All three dimensions of sustainability of civil engineering works (environmental, social and economic) are necessary elements in a systematic approach to a sustainability performance assessment. Any statement or communication on the sustainability performance of a civil engineering works shall address all three dimensions.

NOTE 2 Assessment of the individual dimensions of sustainability can also be undertaken separately, depending on the scope of the assessment, in which case statements are limited to only the dimension(s) for the separate assessment(s) — environmental, social, economic — actually carried out, and not to overall sustainability assessment.

The sustainability performance of a civil engineering works depends on the characteristics of the climatic, social, economic and cultural context of the nation, region and site where the civil engineering works is located.

Subject to the aims and objectives of the assessment, quantitative and qualitative indicators for measuring the sustainability performance of a civil engineering works should be expressed by absolute values. Qualitative indicators can often be converted to absolute values. For example, “true=1; false=0” or “low=1; medium=2; high=3”.

In addition, relative values may be used alongside the absolute values. Relative values refer to given contexts and should reflect regionally relevant benchmarks as appropriate (see 5.8.6).

NOTE 3 The characteristics and relevance of local contexts can allow for the co-existence of both regional and national methods for the assessment of the sustainability performance of civil engineering works.

Both regional and national methods for the assessment of the sustainability performance of civil engineering works may co-exist, based on the different characteristics and relevance of local contexts, provided the methods conform to the framework requirements described in this document.

To assess the environmental, social and economic performance, the functional equivalent and the system boundaries for each shall be the same. By reference to the functional equivalent, the results of assessments can be presented in a systematic way. The functional equivalent, along with the system boundary, forms the basis for comparison at the civil engineering works level.

Any technical and functional requirements prescribed in the client's brief, in the project specification or in the applicable regulation shall be taken into account in the description of the functional equivalent.

NOTE 4 For example, the technical and functional requirements can include requirements on structural safety; safety provided by the civil engineering works; air, water and soil quality; resources efficiency; biodiversity protection; landscape changes; land use; and noise and vibrations of a civil engineering works or an assembled system (part of works).

It is advisable to carry out an assessment at the earliest opportunity during the conceptual stages of a construction or refurbishment project, such as in the initial planning stage, in order to provide a broad estimate of the environmental performance, social performance and economic performance. As the project evolves, the assessment may be periodically reviewed and updated to support decision-making. A final assessment (as-built) should be carried out. The results of this final assessment can be used to inform all parties concerned.

5 Framework for methods of assessment of sustainability performance of civil engineering works

5.1 General

This clause gives the minimum requirements and additional recommendations for consideration in the development, understanding, implementation and improvement of methods of assessment of the sustainability performance of civil engineering works.

The assessment of the environmental performance shall be based on the life cycle assessment (LCA) in accordance with ISO 14040, ISO 14044 and additional quantifiable environmental information.

NOTE 1 This does not intend to require that a LCA be undertaken.

The assessment of the economic performance shall be based on cost and financial value.

NOTE 2 Guidance on life cycle costing is provided in ISO 15686-5.

The assessment of the social performance shall take into account risk assessments and consider users' satisfaction surveys, human rights, labour rights and health and safety of relevant stakeholders throughout the life cycle of the construction works.

An assessment method may comprise more than one methodological part: quantification, analytical and valuation(s). The provisions of this document do not set levels, classes or benchmarks for any measure of performance.

There is no scientific basis for reducing the results of a life cycle assessment to a single overall score or number; any such approach is outside the scope of this document. However, calculation rules for aggregation of indicators may be defined in the national standards or schemes according to national or local preferences.

5.2 Assessment method documentation

The documentation of the assessment method shall identify

— the body responsible for the development and the maintenance of the method,

— details of stakeholder involvement in the development and validation of the method,

— national/regional/organizational means of recognition of the method and/or its accreditation, and

— processes and procedures for the delivery of the assessment (e.g., workflow, training, communication).

The method shall include and clearly describe

— the object of assessment,

— the purpose of the method (5.3),

— the system boundary (5.4),

— a statement of the assumptions and scenarios (5.5),

— a structured list of the issues for assessment (5.6),

— the life cycle stages of the civil engineering works covered (5.7),

— the method(s) for the quantification of the sustainability performance of the civil engineering works (5.8),

— all sources of information (generic and specific databases, etc.) and their requirements (5.9),

— an evaluation and interpretation process (5.10),

— the indicators and calculation procedures, and

— the requirements for presentation of the results in reporting and communication (5.11).

In addition to the description of the method, statements regarding the assessment-specific assumptions, methods for the quantification and sources of information shall be recorded in the report containing the assessment results.

The methods should not include the interpretation and evaluation of the results of the assessment. The indicators should be performance-based.

The environmental information from construction products, processes and services for the assessment of environmental performance of civil engineering works should be provided by the Type III environmental product declarations in accordance with ISO 21930, when available.

5.3 Purpose of the method

The documentation of the assessment method shall indicate the intended use, which shall be related to the application of the method and expected use of the assessment results.

The reasons for the assessment of the sustainability performance of a civil engineering works often vary, depending on the particular circumstances. A method for the assessment of the sustainability performance of a civil engineering works provides a means for the measurement and evaluation of the various aspects and potential impacts of a civil engineering works.

NOTE 1 Intended uses can include, for example:

— to evaluate options for

  — procurement of a civil engineering works,

  — design and construction of a new civil engineering works,

  — improving operation of an existing civil engineering works,

  — designing for retrofit and refurbishment during the operating phase,

— the analysis of the sustainability performance of an existing civil engineering works,

— the deconstruction and disposal at the end of the operating phase,

— monitoring the progress toward the improvement of performance,

— use as the basis for benchmarking, and/or

— communication to interested parties.

5.4 System boundary

The documentation of the assessment method shall indicate the physical scope (e.g., the object of assessment), the temporal scope and the energy and mass flow(s) that are considered or not considered in the assessment. Whenever possible, the method of assessment shall include the whole civil engineering works, its area of influence, its services, its external works and associated temporary works, and its site; for its entire life cycle, including upstream and downstream processes.

Given that the area of influence is not always limited to the civil engineering works itself, or within some set distance from this area, the area of influence shall be defined for every typology of civil engineering

works and for each of the three dimensions of sustainability (environmental, social and economic). The definition of the spatial (geographical) boundaries is a part of the system boundary definition.

NOTE 1 Since the area of influence is variable and dependent on several factors (e.g. typology, location and life cycle stage of the civil engineering works), defining the area of influence is an important step when performing a sustainability performance assessment.

EXAMPLE 1 In a harbour, the object of assessment would be the harbour itself, the area of influence related to land use will, in general, be localized and restricted to the civil engineering works itself and immediate surroundings, whereas the area of influence related to releases of pollutants to a water body can be limited to a restricted sea area, but could extend widely, depending, for example, on the nature of ocean currents.

In practice, however, the system boundary for the assessment may be determined by the intended use of the assessment, by the users and stakeholders, by the stages of the civil engineering works life cycle to which the method is applied and by the assumptions underlying the assessment.

Methods of assessment of the sustainability performance of civil engineering works shall clearly define the different elements of the system boundary or boundaries used. When the assessment is restricted to a part of a civil engineering works or to a part of the life cycle, or if any relevant sustainability issue is not addressed, this shall be documented and reasons explained.

NOTE 2 Sensitivity analysis can be used to describe the potential influence of the non-assessed aspects and justify this non-assessment.

The system boundary for the assessment shall be defined in the scope of the assessment.

The setting of the system boundaries shall follow the "modularity principle" in accordance with ISO 14025:2006, 5.4.

NOTE 3 For instance, the cradle to grave EPD according to ISO 21930, if available, can be a source of some information from construction products for the assessment.

When the civil engineering works provides additional functions that were not included in the primary client's brief, these different functions shall be taken into account in the assessment, as part of the system boundary.

EXAMPLE 2 Telephone cables provided along a highway or power generation facilities provided by a dam that was required to be designed only for flood defence.

The aspects and impacts arising from the user's use of the civil engineering works for its intended function shall also be considered in the assessment, if relevant.

NOTE 4 An example of an aspect arising from the user's use of the civil engineering works can be fuel consumed by cars during the use stage of a road.

5.5 Statement of assumptions and scenarios

The method of assessment should apply either a fixed set of assumptions and scenarios, offer the user a choice between several default assumptions and scenarios, offer the user a free definition of assumptions and scenarios, or any combination thereof.

In any case, assessments shall be established on the basis of specified scenarios that represent the civil engineering works life cycle. The applied scenarios shall be described or referenced in the assessment report and made available for communication. The scenarios shall be realistic and representative and in accordance with the technical and functional requirements expressed in the functional equivalent.

Information relating to the object of assessment and the functional and technical requirements shall be taken from the client's brief, the regulatory requirements and the project specification.

The estimated service life of a civil engineering works or assembled system (part of works) shall be established in accordance with specific rules and guidance given in ISO 15686-1, ISO 15686-2, ISO 15686-7, ISO 15686-8 and ISO/TS 15686-9.

NOTE In this context, "estimated service life" refers to the service life that a civil engineering works or parts of a civil engineering works would be expected to have in a set of specific in-use conditions (ISO 21930:2017, 3.2.15), determined from reference service life data (ISO 21930:2017, 3.2.17) after taking into account any differences from the reference in use conditions (ISO 21930:2017, 3.2.16).

The documentation of the assessment method shall include statements regarding the general assumptions and scenarios used in the assessment. Civil engineering works-specific assumptions and scenario(s) shall be defined and modelled explicitly and shall be stated in the assessment report (see 5.11).

Wherever possible, relevant information about an assessment of the sustainability performance of an existing civil engineering works shall be based on a field survey and measurement.

At different points in the life of a civil engineering works project, assumptions have to be made. For example, at the concept stage there might be little information of the proposed details of a civil engineering works, and many assumptions are required. As the project progresses, the details are refined and assumptions are replaced by specific information.

5.6 Establishing assessment categories

Sustainability performance assessment methods shall be structured and shall organize the process into categories of issues that shall be considered. These categories shall include significant issues developed throughout the project related to the three dimensions of sustainability.

As noted earlier in this document, sustainability performance assessment covers the consideration of environmental, social and economic dimensions. It is noted that many categories of significant issues could fit into more than one sustainability dimension. When that happens, the issue shall only be mentioned in one of them, to avoid repetition.

The following categories of sustainability issues shall be covered, where relevant:

Environmental performance

— Water management (quality, quantity, regulation)

— Energy use

— Resource use (renewable and non-renewable, toxic substances)

— Waste management

— Pollution/emissions (to air, soil, water)

— Noise and vibration

— Landscape changes

— Ecosystem health

— Consequences of the choice of construction products

Social performance

— Accessibility

— Adaptability

— Health and comfort

— Human rights

— Loadings on the surroundings

— Risk, resilience and adaptation

— Sourcing of materials and services

— Stakeholder involvement

— Job creation

— Population system

— Cultural heritage elements

Economic performance

— Life cycle costs

— External costs

— Urban and land planning

— Effects on local economy

Performance issues related to the management processes for construction, delivery, operation and maintenance may be part of the previous three dimensions of sustainability.

5.7 Civil engineering works life cycle

The results of the assessment of the sustainability performance of a civil engineering works are directly influenced by the point within the life cycle of the civil engineering works at which the assessment is being made. Therefore, methods of assessment of the sustainability performance shall clearly document what life cycle stages are relevant to each sustainability issue considered in the method.

The aspects and impacts of a civil engineering works that relate to its environmental, social and economic performance are influenced by actions that start with the consideration of the need for a civil engineering works and continue beyond the decommissioning of the civil engineering works (i.e. the legacy that is left behind once the civil engineering works has been demolished/disposed of).

The life cycle is understood as a set of subdivided information modules that may be assessed and combined in different ways.

Figure 2 illustrates a modular structure of the life cycle stages of a civil engineering works. The life cycle of a civil engineering works may be looked at from different perspectives, for example, from the physical point of view or from a project management point of view.

NOTE 1 A civil engineering works project starts with a consideration of the need for, and functions required of, a civil engineering works, followed by the decision whether to build a new civil engineering works or refurbish an existing one, and then proceeds through the contractual arrangements for procurement, design and specification, acquisition of land (if needed) and materials, construction, hand over and use.

Civil engineering works life cycle information within the system boundary																
A0	**A1-A3**			**A4-A5**		**B1-B8**						**C1-C5**				
PRECONS-TRUCTION	**PRODUCTION STAGE**			**CONSTRUC-TION STAGE**		**USE STAGE**						**END OF LIFE STAGE**				
Land and associated fees / advice	Raw material supply	Transport and all upstream processes from cradle to gate	Manufacturing of products	Transportation to the site	Construction of the civil engineering works	Use	Maintenance	Repair	Replacement	Refurbishment	Use of energy resources, use of material resources, use of water and waste management from the operation of the civil engineering works	Deconstruction / Demolition	Transport to waste processing or disposal	Waste processing	Disposal of waste	Re-landscaping
				Scenario	Scenario	Scenario	Scenario	Scenario	Scenario	Scenario	Scenario	Scenario	Scenario	Scenario	Scenario	Scenario
A0	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6-B8	C1	C2	C3	C4	C5

Optional supplementary information beyond the system boundary
Potential net benefits from reuse, recycling and/or energy recovery, beyond the system boundary
Scenario
D

Figure 2 — Common life cycle stages and their information modules for a civil engineering works and the optional supplementary module D

The stage before the handover of the civil engineering works includes the following information modules:

— Pre-construction stage, including
  — land and associated fees/advice;
— Production stage, including
  — raw material supply,
  — transport and all upstream processes from cradle to gate, and
  — manufacturing of products;
— Construction stage, including information modules for
  — transport to the civil engineering works site, and
  — civil engineering works installation/construction.

After the handover of the civil engineering works, the use stage information modules include

— use,
— maintenance,
— repair and replacement (including upstream and downstream processes),

— refurbishment, (including upstream and downstream processes), and

— use of energy resources, use of material resources, use of water and waste management from the operation of the civil engineering works.

The end of life stage information modules include

— deconstruction,

— transport,

— reuse, recycling, recovery for energy,

— disposal, and

— re-landscaping.

As an option, supplementary information may be provided (module D) that addresses potential benefits beyond the system boundary of the civil engineering works under study.

NOTE 2 This supplementary information (module D) can be relevant for the consideration of subsequent product systems as it relates to the potential environmental benefits and loads of the net output flows of secondary materials and/or fuels or recovered energy, which can result if the construction product used in the civil engineering works is reused, recycled or recovered in the future.

All life cycle stages A to C shall be considered in the assessment. When it is not relevant to consider some stages or some are excluded from the assessment, the reasons for such omission or exclusion shall be clearly explained in the documentation of the assessment method. The assessment report shall state what life stages are included and what life cycle stages are excluded.

The additional functions that go along with the primary function, and which provide a service that impact the environment, social and economic performance, shall be reported and assessed under the individual information modules (modules A to C).

NOTE 3 Examples of additional functions are power generation in a flood barrier, bio gas production and/or electricity generation in a sewage water plant, humid micro climate conditions up-stream of a water barrier and lower water table downstream of a water barrier, (difference in) fuel or energy consumption for a road or train track.

EXAMPLE The functional equivalent considered for a dam is water supply. In such a case, if one of the alternatives includes energy generation as an additional function, and other alternatives don't, such energy supply is not part of the functional equivalent, but has to be included in the assessment process.

For treatment of secondary materials and/or fuels crossing (entering or leaving) the system boundary, including the development of information related to module D, see ISO 21930.

For the assessment of the sustainability performance of a civil engineering works, the life cycle starts with the preparatory works and administrative processes. It proceeds through the contractual arrangements for design and specification, acquisition of raw materials, manufacturing and procurement of products, construction work processes, handover for use, commissioning, actual use including maintenance, repair, replacement, refurbishment and operation of the civil engineering works and finally at the end of life, decommissioning, deconstruction or demolition, waste processing in preparation for reuse, recycling and energy recovery and other recovery operations, and disposal of waste.

Information from these decisions and activities is needed to assess the environmental, social and economic aspects and impacts of the civil engineering works.

For the purposes of the economic assessment, the "product stage" shall include the assessment of pre-construction costs such as design fees etc., and also any land value which is included in the assessment.

The "use stage" is one of the life cycle stages of a civil engineering works. The information modules (B1 to B8) shown within Figure 2 as part of the use stage distinguish between environmental, social and economic impacts as a consequence of the civil engineering works being in place (i.e. information

modules B1 to B5) and as a consequence of the use of operational energy and water flows of the civil engineering works (i.e. information modules B6 to B8), which are required to be reported separately.

To assess the economic performance of some projects, it is essential to include revenues in the assessment. For example, a civil engineering works involving an integrated renewable energy installation cannot be justified on the environmental, social and economic performance without taking into account revenue from the energy generated and any avoided energy costs arising from the renewable energy source.

The information allocated to the relevant information modules should be taken from appropriate sources.

NOTE 4 Examples of appropriate sources include the procedures in ISO 15686-5 and historical cost data.

The assessment method shall describe the detailed calculation methods and appropriate sources of data for the environmental, social and economic indicators.

The life span of civil engineering works is sometimes difficult to define. If this is the case, a reference study period shall be defined for assessment purposes, and shall be at least equal to the required service life.

If the reference study period is longer than the required service life, the remaining life span of the civil engineering works beyond the reference study period, if any, depending on the scenario, shall also be considered.

NOTE 5 In this context, "required service life" refers to the service life required either by the client or through regulations. The required service life is considered in the calculation of replacements at both the construction product level and construction works level and refurbishment.

The complete assessment of the sustainability performance of a civil engineering works comprises two elements:

a) aspects and impacts specific to civil engineering works itself and its site during all life cycle stages:
   - before use stage (information modules A0 and A1 to A5):
     - pre-construction stage;
     - product stage (including planning, design and material acquisition);
     - construction process stage (including transportation);

     NOTE 6 The economic framework addresses intangible costs that start at information module A0, which includes costs incurred prior to the product and construction stages, such as site costs and related professional services. The environmental and social frameworks address physical impacts that start at module A1.
   - use stage (information modules B1 to B5);
   - end of life stage (information modules C1 to C5);
   - optional supplementary information regarding the benefits and loads beyond the system boundary (module D);

b) aspects and impacts specific to civil engineering works in operation:
   - use stage (information modules B6 to B8);
   - optional supplementary information regarding the benefits and loads beyond the system boundary (module D).

The environmental, social and economic aspects and impacts beyond the civil engineering works life cycle shall, where included, be represented by optional supplementary information described under module D. The aspects and impacts addressed in the information included under module D may include

further reuse, recycling and energy recovery and other recovery operations not included in the civil engineering works life cycle.

5.8 Methods for quantification of sustainability performance of civil engineering works

5.8.1 General

The measurement of the sustainability performance of a civil engineering works requires indicators for the sustainable issues selected (see 5.6). Indicators may be qualitative or quantitative.

Methods for quantification of the sustainability performance of a civil engineering works are composed of

— a methodology to measure the sustainability performance by specific issues, and

— a methodology to aggregate the results of measurement of the sustainability performance from multiple issues.

Qualitative sustainability performance may be expressed in a quantitative way by several means, such as rating or scoring. The evaluation of qualitative sustainability performance, which has no direct means for quantification, may be made by consensus or by agreement.

5.8.2 Data quality

The quality of data used for the assessment of the sustainability performance of a civil engineering works will influence the results. The assessment shall use data, where available, specific to the civil engineering works under consideration. If such data are not available, generic data from reference documents may be used provided it is appropriate to the civil engineering works under study.

Where EPD data are used for the environmental performance assessment, the data shall comply with ISO 21930 or some equivalent consensus standard and shall cover all life cycle stages included within the defined scope of the assessment. However, the assessment shall include, if relevant, indicators that address all environmental performance issues identified in 5.6, which will require that some data be completed with information sources other than an EPD.

Where cost data are used for the economic performance assessment, they shall be as accurate and current as possible for the stage of the project. The reference year of the cost data shall be stated.

Other quantitative data shall comply with scientific and engineering principles.

NOTE Data used in the assessment of the sustainability performance of a civil engineering works can include

— data related to and describing the civil engineering works and its life cycle,

— data related to products and services used,

— reference data, and

— data related to converting civil engineering works activity and processes into impacts.

Where possible, the assessment method should provide guidance on how uncertainty in data can be tested and managed through the use of sensitivity analysis (for a given range of possible values) and/or probabilistic analysis (where there is a well understood distribution of possible values).

5.8.3 Traceability and transparency

Data regarding the assessment method and result of the assessment shall be transparent and traceable. Transparency encompasses the presentation of information in a manner that is open, comprehensive and understandable.

The assessment methods shall define the requirements for transparency of data, methodologies, results, reporting and communication. Applied scenarios shall be defined and modelled explicitly and made available for communication.

Data used in and the results of the assessment of environmental, social and economic performance shall be verifiable. Methods for the assessment of the sustainability performance of civil engineering works shall clearly indicate the way in which the results have been derived in order to make it possible to trace them back to the original data. The method of assessment shall ensure consistency of the results of assessment by requiring the traceability of data throughout the assessment.

5.8.4 Double-counting

As far as possible, the assessment methods shall ensure that double counting of sustainability performance aspects and impacts is avoided in order to prevent distortion of the assessment results.

NOTE When one action or measure has several effects, it can be said to have a "multiple-effect". Double counting is not to be confused with measuring multiple-effects where aspects of the civil engineering works will influence environmental, economic and social performance. For example, traffic flow has influence on user's time saving (social), climate change and depletion of natural resources (environmental), and user's costs (economic), which are multi-effects recognised in the separate assessments. Another example, the avoidance of the use of CFCs has the multi-effect of preventing ozone layer depletion as well as global warming.

5.8.5 Functional equivalent

The functional equivalent is the reference parameter in the determination of sustainability performance and is instrumental in the quantification of civil engineering works performance and of users' requirements.

A civil engineering works or a part of a civil engineering works may have a number of possible functions.

Comparisons between the results of assessments of civil engineering works shall only be made on the basis of their functional equivalence. The major functional requirements shall be described together with intended use and the relevant specific technical requirements to establish the functional equivalent. This allows for the comparability of the individual functional equivalents of different options and civil engineering works types to be determined and forms the basis for transparent and reasonable comparison. If assessment results based on originally different functional equivalents are used for comparisons, a new common functional equivalent shall be defined and the basis and conditions for this comparison shall be made clear.

The functional equivalent shall include, but is not necessarily limited to

— type/use of civil engineering works (dam, harbour, road, etc.),

— capacity,

— period and pattern of use,

— design life, and

— user requirements.

NOTE 1 In this context, "design life" refers to the service life intended by the designer. It is stated by the designer to the client to support specification decisions.

When combining separate assessments of the environmental, social and economic performance for a sustainability performance assessment, the same functional equivalent shall be used for the assessment of each of the individual dimensions of sustainability.

NOTE 2 According to the civil engineering works typology, functional equivalents can be developed from the following non-exhaustive list of examples:

— creation of a new means of travel between A and B with a defined capacity;

— creation of a source of supply of a defined amount of energy per year;

— creation of a harbour to handle a defined number of tonnes of equivalent units;

— creation of a barrier to defend a city from the risk of flooding for a defined rainfall event;

— creation of a foundation system for a defined load-bearing capacity.

5.8.6 Reference levels

Reference levels and/or scale of values may be used in the quantification of indicators as benchmarks for assessing sustainability performance within the assessment method. Reference levels shall be documented and justified.

NOTE 1 The reference level and scale of values can be related to civil engineering works codes/regulations, user requirements and/or evaluation of conditions in the area where the civil engineering works is located.

NOTE 2 Conditions in the area to be evaluated to establish reference levels can refer to social, economic or environmental conditions such as previous water quality of the environment where the civil engineering works is placed or level of unemployed people in the area of influence where jobs are going to be created.

Quantitative information on the sustainability performance may be referred to a predefined baseline. In such a case, the reason or basis for setting the baseline shall be clearly documented.

5.8.7 Aggregation

The sustainability performance assessed in relation to a specific category of sustainability issues (see 5.6) may be aggregated from the values of multiple category indicators. Aggregation methodologies shall, where appropriate and available, use conversion factors that comply with scientific or engineering principles.

NOTE Weighting can be used if such conversion factors are not available (see 5.8.8).

The method used to aggregate the results of the measurement of sustainability performance by multiple category indicators shall be clearly stated.

Loads/benefits described in the supplementary information that may be included under optional module D shall not be aggregated with the life cycle information modules (A0 to C5) to assess the total impact of the civil engineering works being compared, as it is outside the system boundary. It can be taken into consideration as optional supplementary environmental information using equivalent scenarios.

Additional information and explanation on aggregation is provided in Annex A.

5.8.8 Weighting

An assessment method that uses aggregated indicators for the assessment results, either implicitly or explicitly, includes a weighting system. The underlying process that supports weighting shall be based on the differences in the relative importance of category indicators and shall be documented.

The weighting system may vary according to national, regional or local contexts and should provide a method for addressing such variances, which shall be documented and justified. The weighting system shall be explained and weighting factors shall be listed in the documentation of the assessment method.

5.9 Sources of information

The sources of information that may be used in the assessment shall be clearly indicated in the documentation of the assessment method, including whether it is from measurements, qualitative judgments, general data from reference documents or calculated values.