INTERNATIONAL STANDARD

ISO 15686-10

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Buildings and constructed assets — Service life planning —

Part 10: When to assess functional performance

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

Partie 10: Quand évaluer la performance fonctionnelle

Reference number
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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 15686-10 was prepared by Technical Committee ISO/TC 59, *Building construction*, Subcommittee SC 14, *Design life*.

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

— *Part 1: General principles and framework*

— *Part 2: Service life prediction procedures*

— *Part 3: Performance audits and reviews*

— *Part 5: Life-cycle costing*

— *Part 6: Procedures for considering environmental impacts*

— *Part 7: Performance evaluation for feedback of service life data from practice*

— *Part 8: Reference service life and service-life estimation*

— *Part 9: Guidance on assessment of service-life data* [Technical Specification]

— *Part 10: When to assess functional performance*

Data requirements is to form the subject of a part 4.

Buildings and constructed assets — Service life planning —

Part 10:
When to assess functional performance

1 Scope

This part of ISO 15686 establishes when to specify or verify functional performance requirements during the service life of buildings and building-related facilities, and when to check the capability of buildings and facilities to meet identified requirements.[1)]

This part of ISO 15686 is applicable to any scope of holdings, whether a set (or portfolio) of buildings, a single building (large or small) or a facility which is part of a building (such as one group of spaces, one floor or several floors). It is applicable to the range of roles of stakeholders, from the owners and managers to the occupants, tenants or other users. It is intended to be used with ISO 15686-1, ISO 15686-2, ISO 15686-3, ISO 15686-5, ISO 15686-6, ISO 15686-7, ISO 15686-8 and ISO 15686-9.

NOTE 1 The principles and methods can be applied to a single-family residence, but this part of ISO 15686 calls for greater frequency and extent of assessing demand and supply than is typically appropriate.[2)]

NOTE 2 The application of this part of ISO 15686 can be required by the client or by any entity having authority, including regulatory authority.

NOTE 3 In Table 2, the column entitled “Outputs called for by other parts of ISO 15686” is provided to show how outputs from other parts of ISO 15686 occur at each phase, whether or not this part of ISO 15686 requires action or output.

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 6707-1:2004, *Building and civil engineering — Vocabulary — Part 1: General terms*

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 15686-3:2002, *Buildings and constructed assets — Service life planning — Part 3: Performance audits and reviews*

1) International Standards for the determination of levels of functionality (demand) and levels of serviceability (supply) are the responsibility of ISO/TC 59 SC 3.

2) International Standards for the description of performance of single-family residences for the purposes of specifying performance requirements and performance levels are the responsibility of ISO/TC 59 SC 15. Standardization work related to the performance of single-family detached and semi-detached dwellings is reflected in ISO 15928 (all parts).

ISO 15686-5:2008, *Buildings and constructed assets — Service life planning — Part 5: Life-cycle costing*

ISO 15686-6, *Buildings and constructed assets — Service life planning — Part 6: Procedures for considering environmental impacts*

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

ISO 15686-8:2008, *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*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 6707-1 and ISO 15686-1 and the following apply.

3.1
asset
whole building, structure or unit of construction works, or a system or component or part thereof

3.2
behaviour in service
how a whole building, structure or unit of construction works, or a system or component or part thereof actually functions in its intended place and use

3.3
client
⟨construction⟩ person or organization responsible for initiating and financing a project and approving the brief

NOTE 1 Adapted from ISO 6707-1:2004, definition 8.3.

NOTE 2 In some countries, the role and qualification of “construction client” is defined by law and regulation, according to the scope and complexity of a project (see Reference [17]).

3.4
degradation
process whereby an action on an item causes a deterioration of one or more properties

NOTE Properties affected may be, for example, physical, mechanical or electrical.

[ISO 15686-8:2008, definition 3.4]

3.5
demand
⟨of a facility⟩ requirement for **functional performance** (3.11)

3.6
disposal
⟨status change⟩ transfer of ownership of, or responsibility for, the object of consideration

3.7
disposal
⟨end of life⟩ transformation of the state of a building or **facility** (3.8) that is no longer of use

NOTE Transformation can include, either individually or in some combination, the decommissioning, deconstruction, recycling and demolition of the object of consideration.

3.8
facility
physical setting used to serve a specific purpose

NOTE 1 A facility may be part of a building, a whole building or more than one building, and may include related constructions (such as roads and walkways), which, taken as a whole, serve a specific **function** (3.10).

NOTE 2 The term encompasses both the physical object(s) and its (their) use.

3.9
feature
element or attribute of a **facility** (3.8) that indicates an aspect of its **serviceability** (3.29)

3.10
function
purpose or activity of **users** (3.34) and other **stakeholders** (3.30) for which an **asset** (3.1) or a **facility** (3.8) is designed, used or required to be used

3.11
functional performance
〈of a facility〉 **performance** (3.19) of a **facility** (3.8) to support required **function**(s) (3.10) under specified use conditions

3.12
functional performance requirement
type and **level of functionality** (3.15) that is required by **stakeholders** (3.30) of a **facility** (3.8), building or other constructed **asset** (3.1), or of an assembly, component or product thereof, or of a movable asset, for a specific **function** (3.10)

3.13
functionality
suitability or usefulness for a specific purpose or activity

3.14
gap
difference between the **level of functionality** (3.15) (or other attribute) that is required and the **level of serviceability** (3.17) (capability) that is or will be provided

3.15
level of functionality
number indicating the relative **functionality** (3.13) required for a **user** (3.34) group or customer for one **topic** (3.33) on a predetermined demand **scale** (3.26) from the level of the least (functionality) to the level of the most (functionality)

NOTE The level of functionality may be the consequence of several distinct **functions** (3.10) required to act in combination.

EXAMPLE Scale of integers from 0 to 9.

3.16
level of performance
number indicating the relative **performance** (3.19) required or provided for one **topic** (3.33) on a predetermined **scale** (3.25) from the level of the least (performance) to the level of the most (performance)

NOTE The level of performance may be the consequence of several distinct performances [**behaviours in service** (3.2)], of which one may be **functional performance** (3.11), which act in combination.

EXAMPLE Scale of integers from 0 to 9.

3.17
level of serviceability
number indicating the relative **serviceability** (3.29) [capability of a **facility** (3.8)] for a **user** (3.34) group or customer for one **topic** (3.33) on a predetermined supply **scale** (3.27) from the level of the least (serviceability) to the most (serviceability)

NOTE The level of serviceability may be the consequence of several distinct physical **features** (3.9) acting in combination.

EXAMPLE Scale of integers from 0 to 9.

3.18
obsolescence
⟨of a facility⟩ inability of a **facility** (3.8) or component thereof to perform satisfactorily due to changes in **performance requirements** (3.20)

3.19
performance
⟨of a facility⟩ **behaviour in service** (3.2) of a **facility** (3.8) for a specified use

NOTE The scope of this performance is of the facility as a system, including its subsystems, components and materials, and their interactions, such as acoustical, hygrothermal, economic and so on, as well as the **relative importance** (3.24) of each **performance requirement** (3.20).

3.20
performance requirement
performance (3.19) demanded or expected of a **facility** (3.8) for a specified use

NOTE Adapted from ISO 6707-1:2004, definition 9.1.16.

3.21
profile
⟨of a facility⟩ list of the **levels of functionality** (3.15) required by **stakeholders** (3.30) for a **facility** (3.8), or the **levels of serviceability** (3.17) provided by a facility, related to various **topics** (3.33)

3.22
rater
individual who conducts the **rating** (3.23) of a **facility** (3.8) or of the design of a facility, to determine its **profile** (3.21) of **serviceability** (3.29)

3.23
rating
process of determining the **serviceability** (3.29) of a constructed **asset** (3.1) or of an asset that has been designed, but not yet built

3.24
relative importance
importance of any one **topic** (3.33) of **functionality** (3.13) for the operations or mission of the **users** (3.34)

3.25
scale
single set of statements in which intervals between statements, from the most to the least, are calibrated according to scalar rules

NOTE When people are asked to select one of the statements in a **scale** (3.26) (3.27) as most closely describing the **level of functionality** (3.15) required or as best describing the physical **features** (3.9) present in a **facility** (3.8), the scale, in effect, functions as a multiple choice questionnaire.

3.26
scale
〈demand〉 **scale** (3.25) for use in determining the **level of functionality** (3.15) of a **facility** (3.8) on one **topic** (3.33) of **functional performance** (3.11)

3.27
scale
〈supply〉 **scale** (3.25) for use in determining the **level of serviceability** (3.17) of a **facility** (3.8) on one **topic** (3.33) of capability

3.28
service life
period of time after installation during which a **facility** (3.8) or its component parts meet(s) or exceed(s) the **performance requirements** (3.20)

NOTE Adapted from ISO 6707-1:2004, definition 9.3.84.

3.29
serviceability
capability of a **facility** (3.8), building or other constructed **asset** (3.1), or of an assembly, component or product thereof, or of a movable asset, to support the **function**(s) (3.10) for which it is designed, used, or required to be used

NOTE Adapted from ISO 6707-1:2004, definitions 9.1.11 (capability) and 9.3.85 (serviceability).

3.30
stakeholder
person or entity with an interest in or concern about a **facility** (3.8)

NOTE The interest may include a financial interest and may be continuing or temporary, as that of a visitor.

3.31
suitability
〈of a facility〉 appropriateness to support the **functions** (3.10) or activities of **users** (3.34) or **stakeholders** (3.30)

3.32
threshold level
number indicating the **level of functionality** (3.15) which, if not provided, would significantly or completely impair the ability of **users** (3.34) to carry out their intended activities or operations

3.33
topic
single aspect of a **facility** (3.8) for which a **level of performance** (3.16) is determined

NOTE Levels of performance that may be determined include **levels of functionality** (3.15), **levels of serviceability** (3.17), **threshold levels** (3.32) and **relative importance** (3.24).

3.34
user
organization, person, animal or object which uses, or is intended to use, a building or other construction works

NOTE 1 This includes any person or entity who uses a **facility** (3.8), whether as occupant, visitor, member of the public or other **stakeholder** (3.30) with interest in the facility.

NOTE 2 Adapted from ISO 6707-1:2004, definition 8.1.

3.35
whole life
period of time over which the **functionality** (3.13) [**functional performance** (3.11)] of a **facility** (3.8) is assessed in service life planning

NOTE 1 The whole life commences with the process of definition of need, before a project is explicitly launched, continues through the process of acquisition and use and operation of the facility, and concludes with **disposal** [(3.6), (3.7)], which involves either a status change or end-of-life action(s).

NOTE 2 The concepts of life cycle and whole life are interrelated, but differ, with the difference primarily based on the object of consideration and context. Within ISO/TC 59, three similar definitions of life cycle are applied; these definitions are given in ISO 14040 (ISO 14040:2006, definition 3.1), ISO 15392 (ISO 15392:2008, definition 3.15) and ISO 15686-5 (ISO 15686-5:2008, definition 3.3.4).

4 Assessing functional performance in service life planning

4.1 Phases and stages in the whole life

The phases and stages of whole life are given in Figure 1 and Tables 1 and 2.

NOTE There is no single International Standard for the phases and stages of the service life or whole life of a building or building-related facility. Table 1 gives a summary of the stages. The stages in Figure 1 and Tables 1 and 2 have therefore been derived from among the many different stages of service life identified in various International Standards of ISO/TC 59 and its subcommittees. The sources and derivation are provided in Annex B.

4.2 When to compare levels of demand and supply during the whole life

Significant gaps between required levels of functionality (demand) and actual or designed levels of serviceability (supply) shall be identified.

Appropriate levels of action shall be determined for the significant gaps identified for large or complex buildings or building-related facilities.

This shall be done at various stages during the whole life, as shown in Table 2. Table 2 states the actions required for assessing functional performance.

If Table 2 requires any action related to gaps between levels of demand and levels of supply, the significance of the gap shall be determined and appropriate action considered.

NOTE 1 The concepts and terms of functionality and of serviceability are summarized in Annex A.

NOTE 2 For the actions and functions to consider at each stage, see Annex C.

NOTE 3 The determination of the required levels of functionality and actual levels of serviceability are described in several references in the Bibliography, some of which have been standardized in one or more countries.

NOTE 4 If a building information model (BIM) is initiated and maintained, and the platform and rules for data format and exchange in the BIM conform to ISO/PAS 16739:2005 Release IFC2x3, it can include a property set giving guidance on how to store information about the functionality and serviceability profiles, and gaps, in the BIM. For the name and internet location of that property set, see Reference [16].

NOTE 5 The concepts of functionality and serviceability incorporate several closely related terms. For example, in Clause 3, terms designating the defined concepts include: function, functionality, functional performance, level of functionality, level of serviceability, suitability and serviceability. Annex A gives information about these concepts. Table A.1 gives a matched list of those and related terms.

Table 1 — Phases and stages of the whole life of a building or building-related facility

Phase		Stage no.	Name
Portfolio management	Portfolio operations	0.1	Portfolio strategy
		0.2	Portfolio requirements
		0.3	Project initiation
	Pre-project stages	1	Conception of need
		2	Feasibility
		3.1	Authorization
		3.2	First procurement
Project delivery		4	Initial or outline conceptual design
		5	Preliminary design
		6.1	Detailed (coordinated) design
		6.2	Construction procurement
		7	Production information
		8.1	Construction
		8.2	Commissioning
Property management		9.1	Asset operations
		9.2	Maintenance and condition management
		9.3	Occupants' facility administration
		9.4	Refurbishment, adaptation, alteration, change of use
		9.5	Change of functional use by occupant
Disposal	Status change	10.1	Disposal preparation
		10.2	Transfer
		10.3	Reinstatement
	End of life	10.4	Decommissioning
		10.5	Deconstruction
		10.6	Recycling
		10.7	Demolition

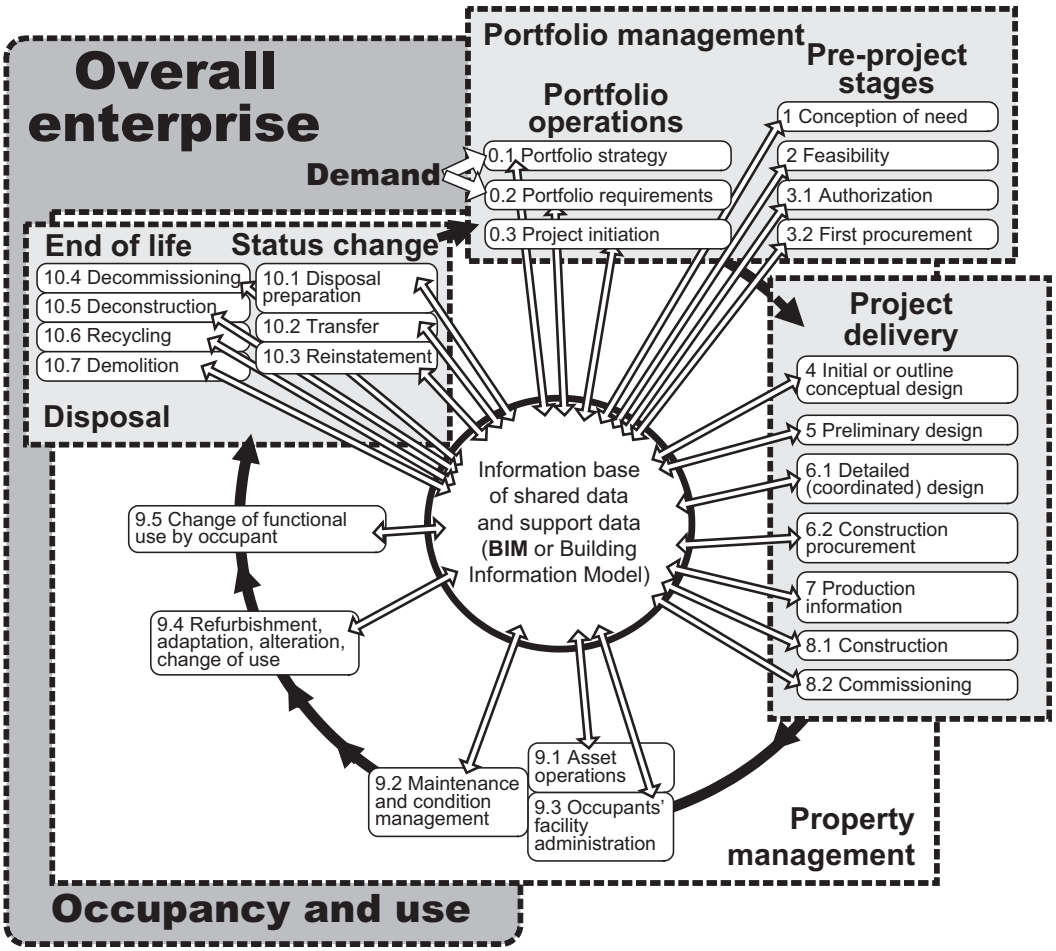


Figure 1 — Schematic diagram of phases and stages in the whole life

Table 2 — Actions required by ISO 15686 (all parts) at each stage of the whole life

Phase		Stage no.	Name	Main task(s) of stage	Actions required by this part of ISO 15686	Outputs called for by other parts of ISO 15686
Portfolio management	Portfolio operations	0.1	Portfolio strategy	— Develop and maintain portfolio strategy, plans and capital project priorities	When developing strategy, plans and project priorities for a portfolio of built assets, any significant gaps between demand profiles and serviceability profiles of the assets shall be considered.	
		0.2	Portfolio requirements	— Create and maintain strategic brief for the portfolio	Strategic brief for the portfolio shall contain the organization's demand profile(s) (generic or typical or organizational).	15686-6: determine environmental goals for the portfolio

Table 2 — Actions required by ISO 15686 (all parts) at each stage of the whole life (*continued*)

Phase		Stage no.	Name	Main task(s) of stage	Actions required by this part of ISO 15686	Outputs called for by other parts of ISO 15686
Portfolio management	Portfolio operations	0.3	Project initiation	— Strategic brief for this specific project, including business and other requirements, and client's functional brief — Initiate and authorize start of project to satisfy requirements	Client's functional brief shall contain any variants of its functional requirement levels from the applicable demand profile(s) (generic or typical or organizational).	15686-3: core audit to determine that service life has been adequately considered 15686-6: determine environmental goals for the project
	Pre-project stages	1	Conception of need	— Identify potential solution options to the need — Identify feasibility factors — Amplify the briefing document, which now includes client's general requirements	Client's requirement shall include a main demand profile and any variants.	15686-5: strategic options analyses for whole-life costing/life-cycle costing 15686-6: document environmental goals and requirements, assumptions, constraints, etc.
		2	Feasibility	— Examine the feasibility of solution options presented in Stage 1 — Conduct substantive feasibility[a] study of recommended option(s), including of procurement process — Define the project in a project brief	Requirement levels shall be confirmed or fine-tuned, and consideration shall be given to whether or not to add or remove functional topics.	15686-3: core audit of brief to determine that the basis for service-life planning during design is adequate 15686-5: analyses for whole-life costing/life-cycle costing
Portfolio management	Pre-project stages	3.1	Authorization	— Select procurement process(es) for recommended option(s)[b] — Assemble budget and other documents for approval — Gain financial approval		15686-3: performance audits and reviews
		3.2	First procurement	— Conduct initial procurement according to the approved process	The demand profile (and variants, if any) shall be included among criteria for what is to be delivered.	15686-3: performance audits and reviews

Table 2 — Actions required by ISO 15686 (all parts) at each stage of the whole life (*continued*)

Phase	Stage no.	Name	Main task(s) of stage	Actions required by this part of ISO 15686	Outputs called for by other parts of ISO 15686
Project delivery	4	Initial or outline conceptual design	— Create major design elements and design options based on the solution option(s) selected	It shall be confirmed that initial or outline conceptual design meets the functional requirement levels, and the significance of any gaps shall be reported.	15686-3: secondary audit of service-life implications of initial concept designs 15686-5: analyses for whole-life costing/life-cycle costing 15686-6: documentation of potential environmental alternatives for the service-life design 15686-6: evaluation of environmental impact of sketched concept
	5	Preliminary design	— Do preliminary design up to start of construction design — Develop operations brief and maintenance brief	It shall be confirmed that preliminary design meets the functional requirement levels, and the significance of any gaps shall be reported.	15686-5: analyses of whole-life costing/life-cycle costing 15686-6: evaluation of environmental impact of conceptual design 15686-8: selection of reference service-life data and estimation of service life 15686-9: assessment of service-life data
Project delivery	6.1	Detailed (coordinated) design	— Develop construction documents, including working drawings and detailed specifications	At about 60 % completion of construction documents, confirm that the design as defined in construction documents meets the functional requirement levels. Significance of any gaps shall be reported.	15686-3: core audit to confirm that design conforms to service-life performance requirements, and that there is adequate information on installation and commissioning 15686-5: analyses of whole-life costing/life-cycle costing 15686-6: evaluation of environmental impact of design 15686-8: selection of reference service-life data and estimation of service life 15686-9: assessment of service-life data

Table 2 — Actions required by ISO 15686 (all parts) at each stage of the whole life (*continued*)

Phase	Stage no.	Name	Main task(s) of stage	Actions required by this part of ISO 15686	Outputs called for by other parts of ISO 15686
Project delivery	6.2	Construction procurement	— Conduct tendering and procurement of construction, if not already committed in an integrated procurement process or not a purchase or lease	If cost cutting is needed, the verification at 60 % of detailed design shall be used as a source of suggestions for which features may be changed with minimal impact on required functionality, as in value analysis or value engineering.	15686-5: evaluation of options for cost cutting for impact on whole-life costing/life-cycle costing 15686-6: evaluation of options for cost cutting for environmental impact
	7	Production information	— Finalize all major deliverables (e.g. electronic and other documents) and proceed to construction		15686-3: performance audits and reviews
	8.1	Construction	— Construct the project		15686-3: secondary audit of compliance regarding components and installation 15686-6: analysis of consistency with environmental goals and requirements
	8.2	Commissioning	— Prepare, fine-tune programming/ briefing, conduct handover, update documentary deliverables, move-in, shakedown and verify	Verify that the facility still meets the functional requirement levels, and report significance of any gaps.	15686-3: secondary audit of implementation and provision of operational and maintenance information
Property management	9.1	Asset operations	— Operate during initial warranty period — Operate during continued use (includes management of outsourced services)	Periodically, e.g. at five-year intervals or before a planned change of occupants, verify that the facility still meets the functional requirement levels, and report significance of any gaps.	15686-3: secondary audit of implementation and adequacy of service-life care 15686-5: analyses of whole-life costing/life-cycle costing 15686-6: analysis of consistency with environmental goals and requirements 15686-7: performance surveys to determine estimated service life 15686-8: selection of reference service-life data and estimation of service life 15686-9: assessment of service-life data

Table 2 — Actions required by ISO 15686 (all parts) at each stage of the whole life (*continued*)

Phase	Stage no.	Name	Main task(s) of stage	Actions required by this part of ISO 15686	Outputs called for by other parts of ISO 15686
Property management	9.2	Maintenance and condition management	— Maintain during use — Monitor condition — Conduct condition-related projects and other actions	If levels of demand and supply of maintenance and of condition are to be assessed, the same methodology as for assessment and gap analysis for functionality shall be considered.	15686-3: secondary audit of implementation and adequacy of service-life care 15686-5: analyses of whole-life costing/life-cycle costing 15686-6: analysis of consistency with environmental goals and requirements 15686-7: performance surveys to determine estimated service life 15686-8: selection of reference service-life data and estimation of service life 15686-9: assessment of service-life data
	9.3	Occupants' facility administration	— Occupants administer and use their facilities	Demand and supply profiles, and significance of gaps, shall be available to the facility administrator.	15686-3: secondary audit of conformance to facility management plan
Property management	9.4	Refurbishment, adaptation, alteration, change of use	— Provide major repairs, replacements and adaptations or alterations	Client's functional brief shall include a main demand profile and any variants for each potential solution. Verify whether this needs to be updated from initial briefs for the facility.	15686-3: secondary audit of conformance to (changed) brief for the works, and implementation 15686-5: analyses for (changed) whole-life costing/life-cycle costing 15686-6: analysis of consistency with environmental goals and requirements 15686-7: performance surveys to determine estimated service life 15686-8: selection of reference service-life data and estimation of service life 15686-9: assessment of service-life data

Table 2 — Actions required by ISO 15686 (all parts) at each stage of the whole life (*continued*)

Phase		Stage no.	Name	Main task(s) of stage	Actions required by this part of ISO 15686	Outputs called for by other parts of ISO 15686
Property management		9.5	Change of functional use by occupant	— Respond to client's changes in function or functional needs	When a change of functional use by occupant(s) is recognized, whether the functional performance requirements for the facility have changed, and whether the supply profile(s) meet(s) that new demand profile, shall be verified, and significance of any gaps shall be reported.	15686-5: analyses of (changed) whole-life costing/life-cycle costing 15686-6: analysis of consistency with (changed) environmental goals and requirements 15686-7: performance surveys to determine estimated service life 15686-8: selection of reference service-life data and estimation of service life 15686-9: assessment of service-life data
Disposal	Status change	10.1	Disposal preparation	— Decide, plan and prepare to dispose	When considering disposal, the actual serviceability profile of the facility shall be compared to the generic or typical functional requirement profile of potential occupants or buyers.	15686-5: analyses of whole-life costing/life-cycle costing 15686-6: analysis of consistency with environmental goals and requirements
		10.2	Transfer	— Dispose of title or control	When considering disposal, the actual serviceability profile of the facility shall be compared to the generic or typical functional requirement profile of potential occupants or buyers.	15686-5: analyses of (changed) whole-life costing/life-cycle costing 15686-6: analysis of consistency of (changed) environmental goals and requirements
		10.3	Reinstatement	— Recover or reinstate facility as an asset		15686-5: analyses of (changed) whole-life costing/life-cycle costing 15686-6: analysis of consistency of (changed) environmental goals and requirements

Table 2 — Actions required by ISO 15686 (all parts) at each stage of the whole life (*continued*)

Phase		Stage no.	Name	Main task(s) of stage	Actions required by this part of ISO 15686	Outputs called for by other parts of ISO 15686
Disposal	End of life	10.4	Decommis-sioning	— Decommissioning		15686-3: secondary audit of conformance to brief for the works and implementation 15686-5: analyses of whole-life costing/life-cycle costing 15686-6: analysis of consistency of (changed) environmental goals and requirements
		10.5	Deconstruction	— Deconstruction		15686-5: analyses of whole-life costing/life-cycle costing 15686-6: analysis of consistency of (changed) environmental goals and requirements
		10.6	Recycling	— Recycling		15686-5: analyses of whole-life costing/life-cycle costing 15686-6: analysis of consistency of (changed) environmental goals and requirements
		10.7	Demolition	— Demolition		15686-5: analyses of whole-life costing/life-cycle costing 15686-6: analysis of consistency of (changed) environmental goals and requirements
Separate from any phase						15686-2: generic method-ology for estimating or predicting of reference service life of component(s)
						15686-6: generic method-ology for estimating or predicting product and material data for life-cycle assessments[c]

NOTE 1 The main demand profile can be a generic profile, a typical or corporate demand profile for its category of facilities or can be specific to the solution.

NOTE 2 The "Outputs called for by other parts of ISO 15686" column contains reference information, which is not a requirement of this part of ISO 15686.

[a] As noted in Table B.1, see substantive feasibility in ISO 29481-1:—, Annex A.

[b] For instance, determine whether the intention is to have a single procurement from an integrated team which designs and constructs the project or a two-stage procurement in which design and specifications are procured first, followed by construction from a separate construction contractor. If it is intended to have a single procurement from an integrated team, this selection occurs at this Stage 3.1, and procurement at Stage 3.2. If the process involves design first and thereafter construction procurement, the design team is selected at Stage 3.1 and procured at Stage 3.2.

[c] Sector-specific International Standards are ISO 21930 for preparing Type III environmental product declarations on building products and ISO 21931-1 for the framework for methods of assessment of the environmental performance of buildings.

4.3 Issues that arise at various stages of the whole life

Table 2 lists many times in the whole life of a building or building-related facility when a functionality profile shall be compared to the serviceability profile and gaps shall be considered. An example of one family of potential issues is given in Annex D.

4.4 Updates and audits of the levels of functionality and serviceability

Even if no apparent changes in occupants or their functions have occurred, after five years, levels of functionality (demand) and levels of serviceability (supply) shall be reviewed, and audited as appropriate (see ISO 15686-3).

For each action identified in the right-hand column of Table 2 (Actions required by this part of ISO 15686), an explicit choice shall be made as to whether or not to gather data and conduct a gap analysis. If the decision is taken to not conduct or review a gap analysis, the identity of the decider shall be recorded.

NOTE 1 Functional adequacy can be audited at any point in the service life. Scales for rating supply (serviceability) can be used to assess what exists and assess what is proposed or expected to be constructed in response to a request for proposals, during design or during use.

The rater shall be qualified to audit the level of serviceability (supply).

NOTE 2 Typically, an experienced rater can acquire sufficient skills in two days of instruction and supervised practice for the first few audits.

Levels of functionality (functional performance requirements) shall be available to the rater at each audit.

5 Estimation of risk and cost consequences due to gaps

5.1 Terms and concepts

The concepts and terms defined in Clause 3 and applied in Clauses 4 and 5 are explained in Annex A.

5.2 During pre-project stages

At the start of the whole life, a strategic brief for a specific potential project (a first statement of requirements) shall be created before cost estimation occurs, before a budget is developed, before a project is approved and started, and before design occurs.

NOTE 1 For examples of statements of requirements, see Reference [25].

NOTE 2 Uncertainty in estimates of project costs can be reduced and costs more easily managed by using demand profiles (lists of levels of functional performance requirements) as a source of criteria for elemental cost estimates and by comparing demand profiles to profiles of completed facilities with known costs. Even before design, the text of the designated levels of the supply scales on each topic provides much of the information needed to identify what is to be costed. To facilitate this, each topic of paired demand and supply scales can be linked to a schedule of elemental cost factors (see Annex A).

5.3 During pre-construction and construction stages

The strategic brief, which shall be provided at the time of project initiation, shall include a demand profile (levels of functional performance requirements). This demand profile shall be confirmed before project authorization. Thereafter, a quick verification of the supply levels of each design option is recommended. This serves to speed up the design process and reduces rework. This applies even at the early stages when there is sufficient information to assign a supply level for only some of the relevant topics. Compliance with levels of demand shall be confirmed before moving to each subsequent pre-construction and construction stage, and as part of the commissioning process.

Demand levels (levels of functional performance requirements) shall be set such that a facility provides the required support to the mission and operations. If cost assessment of non-construction costs and benefits (impacts on users) are likely to be a consideration, a whole-life costing assessment shall be required (see ISO 15686-5).

NOTE This is particularly valuable in the processes called “value analysis” or “value engineering” to ensure that when reviewing a design for best construction value, essential requirements and minimum threshold levels of demand are not inadvertently compromised. At the same time, comparing the rated levels of supply of a proposed design to the levels of demand can identify topics for which a greater than needed level of supply has been proposed, thereby targeting potential cost savings which do not jeopardize essential functional performance.

Annex A
(informative)

Concepts of functionality and serviceability

A.1 How requirements and serviceability are expressed

NOTE The terms in this annex are defined in Clause 3. Two other terms, usability and satisfaction, are defined in other relevant International Standards or professional documentation.

Users of and other stakeholders in a building or building-related facility require that it meet their needs to some definable extent. Since most are not able to express their requirements in the precise technical language of the building industry, tools have been developed to help them specify how much of each kind or topic of functionality is required and how much is provided.

This annex discusses how the concepts of functionality and serviceability work together and how these terms relate to other terms used in this part of ISO 15686 and other related International Standards.

Users or other stakeholders usually document their requirements for functionality in a programme or brief written in a language that they understand. These documents summarize the purposes, needs, functions and activities of the users and other stakeholders to be met by a facility. The serviceability of a facility is its capability to provide that functionality, that is, how serviceable it is to support those who have that requirement.

A.2 Using profiles

The description of what people require in order to be able to do what they want or need to do is called the required level of functionality on a given topic. Taken together, these levels of functionality form a profile of the requirements of the users and stakeholders. The extent to which the place is suitable or useful in relation to one of the topics describing the users' requirements is called a level of serviceability for that topic. Taken together they form a profile of serviceability which can be matched to the profile of functionality. The suitability of a facility is assessed when the two profiles are compared.

For instance, consider the place where an individual does office work in an accounting firm, or the place where a family eats dinner at home, or the place where a family doctor examines a patient. Each such place can be more or less suitable or useful for what each set of users and other stakeholders wants to do. If the place is not as suitable or useful as is required, there is a gap between the level of functionality required and the level of serviceability provided for that use by the place.

A.3 Using scales to determine levels

When considering what level (how much or how little) of a particular topic of functionality is required to support the users or other stakeholders, one thinks of the several topics which, together, describe their needs.

For instance, the functionality required by users of an office is affected by topics such as illumination, speech privacy, load capacity of floors (e.g. strong enough to support desks and file cabinets) and freedom from distracting sounds. How much of each of such topics is needed by the users, or other stakeholders, is their level of functional performance requirement, such as sufficient illumination to facilitate the reading of very small print, or sufficient freedom from reflected glare to facilitate the effortless reading of a computer screen.

In another example, such as the functionality required relative to the image of a building to the public and occupants, and specifically as it relates to the identity outside of the building, a requirement scale at level 9 would require the building to be easy to identify and find, even for a visitor to the city or town. An organization

that requires the “most” on this topic might be a large retail store, for which being easily found, both by (local) residents and visitors to the city, is desirable. At the other extreme, an organization that would want the “least” outside identity, that might want to be the hardest to find, level 1, can be the covert operations of the secret service. Therefore, in this instance, level 9 is not inherently better or worse than a level 1. “Goodness”, or fit, depends on how well the building meets the needs of the occupants.

To simplify, stating how much and what kind of illumination or ease of identification is required, this part of ISO 15686 calls for users and other stakeholders to be able to choose from a range of options, expressed in a scale, from least to most.

And, as already noted in the case regarding outside identity, a level 9 can be the most of a topic that one might reasonably require and a level 1 might be the least. A level zero might be a requirement that there should be none of the topic or attribute in the facility.

Two other concepts, usability and satisfaction, are explained in A.4 and A.5 to show how they relate to the terms functionality, serviceability and capability.

A.4 Usability of products

Usability (ISO 9241-11:1998, 3.1) has been defined in International Standards in terms of certain products. A product of manufacture, made in quantities of identical products, such as a computer terminal, should meet the functional requirements of its users.

For instance, ISO 9241-11 defines the concept usability as the “extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use.”. As explained in ISO 9241-11:1998, Annex D, the usability of a product could be measured by “analysis of the features of the product, required for a particular context of use", by “analysis of the process of interaction” with the product, and by “analysing the effectiveness and efficiency which results from use of the product in a particular context and measuring the satisfaction of the users of the product.”. Usability, as defined in ISO 9241-11:1998, Annex D, “also depends on software qualities which […] contribute to quality of the work system in use. […] This broad approach has the advantage that it concentrates on the real purpose of design of a product – that it meets the needs of real users carrying out real tasks in a real technical, physical and organizational environment.”.

If buildings are also considered to be tools or aids to users, the concept of usability also applies, although, unlike manufactured products, each building or building-related facility is unique at least in its physical location, and typically in its specific combination of features.

A.5 Satisfaction as an indicator

Satisfaction (see ISO 9241-11:1998, 3.4) of users is an indicator of serviceability and of when to give priority to resolving problems in a building. Several large corporations and government providers of facilities in many countries use satisfaction surveys as part of their facility management toolkit.

For instance, for several years, the General Services Administration (GSA) of the USA, the provider and facility manager of offices for the government of the USA, conducted a comprehensive user satisfaction survey of all the offices it provided. It adapted the survey developed for the International Facility Management Association (see Reference [22]) and set a target level for occupant satisfaction. The GSA found that occupant satisfaction was not a good indicator of which buildings most needed fixing, because of two intervening variables:

a) occupant satisfaction was dominated by the perceived responsiveness and helpfulness of the personnel providing facility management, rather then by the serviceability of the physical building;

b) typically, respondents mistakenly thought that the facility administrators in their own units, to whom they took their complaints, were the facility managers, rather than the GSA personnel who actually manage the buildings of most government agencies.

A.6 Performance approach and its terms

NOTE These terms are compatible with the Performance System Model proposed by the Inter-jurisdictional Regulatory Collaboration Committee (IRCC) and with the terms used in the CIB Report 64 (Reference [20]).

To accomplish the aims, objectives, goals and targets of society, groups and individuals, there is a trend towards the use of a "performance approach" to define levels of expected results, describe levels of the service or product that would provide the required results and measure levels of actual results.

The suitability of a building or building-related facility is determined by comparing the levels of performance required (demand) and the levels of performance provided (supply). The terms in Table A.1 reflect this dialogue between demand and supply in a consistent way.

Demand scales may serve as multiple choice questions used by occupants or other stakeholders to set the functionality requirement levels needed, such that they can do their required or desired functions or activities. Supply scales use descriptions of physical features as indicators of levels of serviceability.

Table A.1 — Demand and supply terms used in the performance approach

Demand Uses – needs – requirements – wants – wishes	**Supply** What is provided in response to demand
Users Occupants – facility managers/building managers, portfolio managers, visitors Other stakeholders, such as investors, insurers, municipalities and code officials	**Constructed and other assets** Facilities – properties – buildings – building systems, components and products Infrastructure assets, such as bridges, highways and municipal waste systems Material
define/state/set	provide/assess/rate/evaluate
inputs	outputs
ends, results, outcomes	means, solutions
functional statement	performance statement
statement of requirements (SOR)	explicit and implicit performance
functional element	physical feature
bundle of required functional elements	combination of physical features
functionality	serviceability
functional performance	technical performance
functionality requirement scales	serviceability rating scales
demand scales	supply scales
user functional requirement	asset/facility capability
functionality profile	serviceability profile
functionality requirement profile	serviceability rating profile
bundle of functions	combination of features
description of functional element	indicator of capability
demand for functionality	supply of serviceability
demand for service life	estimated or predicted service life
level of functionality (0 and 1-9)	level of serviceability (0 and 1-9)
level of demand (0 and 1-9)	level of service (0 and 1-9)
criteria	measure/verification/test method, etc.

Annex B
(informative)

Derivation of stages in the service life from other International Standards

This annex shows the sources and derivations of the content as listed in Tables 1 and 2. Table B.1 links the stages in Tables 1 and 2 to the content of columns 2, 3 and 4 of ISO 29481-1:—, Table A.1.

Table B.1 — Links between Table 1 and ISO 29481-1:—, Table A.1

ISO 29481-1:—, Table A.1				This part of ISO 15686, Table 1			
Stage		**Name**	**Standard definition in ISO 29481-1:—, Table A.1**	**Phase**	**Stage no.**	**Stage name**	**Main task(s) of stage**
Pre-project stage	0	Portfolio requirements	Establish the need for a project to satisfy the client's business requirement	Portfolio operations	0.1	Portfolio strategy	— Develop and maintain portfolio strategy, plans and capital project priorities
					0.2	Portfolio requirements	— Create and maintain strategic brief for the portfolio
					0.3	Project initiation[a]	— Strategic brief for this specific project, including business and other requirements, and client's functional brief — Initiate and authorize start of project to satisfy requirements
	1	Conception of need	Identify potential solutions to the need and plan for feasibility	Pre-project stages	1.0	Conception of need[b]	— Identify potential solution options to the need and plan for feasibility — Create pre-briefing document, which includes client's general requirements
	2	Outline feasibility	Examine the feasibility of options presented in Phase 1 and decide which of these should be considered for substantive feasibility		2.0	Feasibility[c]	— Examine the feasibility of solution options presented in Stage 1 — Conduct substantive feasibility study of recommended option(s), including of procurement process — Define the project in a project brief

Table B.1 — Links between Table 1 and ISO 29481-1:—, Table A.1 (*continued*)

ISO 29481-1:—, Table A.1				This part of ISO 15686, Table 1			
Stage		**Name**	**Standard definition in ISO 29481-1:—, Table A.1**	**Phase**	**Stage no.**	**Stage name**	**Main task(s) of stage**
Pre-project stage	3	Substantive feasibility	Gain financial approval	Pre-project stages	3.1	Authorization	— Select procurement process for recommended option(s) — Assemble budget and other documents for approval — Gain financial approval
					3.2	First procurement	— Conduct procurement according to the approved process
Pre-construction stages	4	Outline conceptual design	Identify major design elements based on the options presented	Project delivery	4	Initial[d] or outline conceptual design	— Create major design elements and design options based on the solution option(s) selected
	5	Full conceptual design	Conceptual design and all deliverables ready for detailed planning approval		5	Preliminary design	— Do preliminary design up to start of construction design — Develop operations brief and maintenance brief
	6	Coordinated design (and procurement)	Fix all major design elements to allow the project to proceed. Gain full financial approval for the project		6.1	Detailed[e] (coordinated) design	— Develop construction documents, including working drawings and detailed specifications
					6.2	Construction procurement	— Conduct tendering and procurement of construction if not already committed in an integrated procurement process, or not a purchase or lease
Construction stages	7	Production information	Finalize all major deliverables and proceed to construction		7	Production information	— Finalize all major deliverables (e.g. electronic and other documents) and proceed to construction
	8	Construction	Hand over the building as planned		8.1	Construction[f]	— Construct the project
					8.2	Commissioning	— Prepare, fine-tune programming/briefing, conduct handover, update documentary deliverables, move-in, shakedown and verify

Table B.1 — Links between Table 1 and ISO 29481-1:—, Table A.1 (*continued*)

ISO 29481-1:—, Table A.1				This part of ISO 15686, Table 1			
Stage		**Name**	**Standard definition in ISO 29481-1:—, Table A.1**	**Phase**	**Stage no.**	**Stage name**	**Main task(s) of stage**
Post-construction stages	9	Operation and maintenance	Operate and maintain the product effectively and efficiently	Property management	9.1	Asset operations[g]	— Operate during initial warranty period — Operate during continued use (includes management of outsourced services)
					9.2	Maintenance and condition management	— Maintain during use — Monitor condition — Conduct condition-related projects and other actions
					9.3	Occupants' facility administration	— Occupants administer and use their facilities
					9.4	Refurbishment, adaptation, alteration, change of use[h]	— Provide major repairs, replacements and adaptations or alterations
					9.5	Change of functional use by occupant	— Respond to client's changes in function or functional needs
Disposal	10	Disposal	Decommission, dismantle and dispose of the components of the project and the project itself according to environmental and health/safety rules	Status change	10.1	Disposal preparation	— Decide, plan and prepare to dispose
					10.2	Transfer	— Dispose of title or control
					10.3	Reinstatement	— Recover or reinstate
				End-of-life[i]	10.4	Decommissioning	— Decommission
					10.5	Deconstruction	— Deconstruct
					10.6	Recycling	— Recycle
					10.7	Demolition	— Demolish

[a] Project initiation is a stage specified in ISO 15686-3:2002, Table 1; project inception is a stage specified in ISO 15392:2008, 6.1, Note 1.

[b] Project conception is a phase specified in ISO 15392:2008, 6.1, Note 1.

[c] Feasibility analysis is a phase specified in ISO 15392:2008, 6.1, Note 1.

[d] Initial design is a stage specified in ISO 15686-3:2002, Table 1.

[e] Detailed design is a stage specified in ISO 15686-3:2002, Table 1 and ISO 21931-1:—, Figure B.3.

[f] Construction is a stage specified in ISO 15686-3:2002, Table 1, ISO 15686-5:2008, Figures 2 and 3, and ISO 21931-1:—, Figures 1 and B.3.

[g] Operation is a stage specified in ISO 15686-5:2008, Figures 2 and 3.

[h] Refurbishment/adaptation/alteration/change of use is a stage specified in ISO 15686-3:2002, Table 1.

[i] End-of-life and recycling are stages specified in ISO 21931-1:—, Figures 1 and B.3, and deconstruction is a stage specified in ISO 21931-1:—, Figure 1. End-of-life, deconstruction and demolition are specified as stages in ISO 21930:2007, Figure 2.

Table B.2 is reproduced in ISO 29481-1:—, Table A.1. It is derived from ISO 22263.

Table B.2 — Stages given in ISO 29481-1:—, Table A.1, derived from ISO 22263

1	2	3	4
ISO 22263 name	**Stage**	**ISO 29481-1:—, Table A.1 name**	**Definition**
Pre-project stages			
Inception	0	Portfolio requirements	Establish the need for a project to satisfy the client's business requirement
Brief	1	Conception of need	Identify potential solutions to the need and plan for feasibility
	2	Outline feasibility	Examine the feasibility of options presented in Phase 1 and decide which of these should be considered for substantive feasibility
	3	Substantive feasibility	Gain financial approval
Pre-construction stages			
Design	4	Outline conceptual design	Identify major design elements based on the options presented
	5	Full conceptual design	Conceptual design and all deliverables ready for detailed planning approval
	6	Coordinated design (and procurement)	Fix all major design elements to allow the project to proceed. Gain full financial approval for the project
Construction stages			
Production	7	Production information	Finalize all major deliverables and proceed to construction
	8	Construction	Hand over the building as planned
Post-construction stages			
Maintenance	9	Operation and maintenance	Operate and maintain the product effectively and efficiently
Demolition	10	Disposal	Decommission, dismantle and dispose of the components of the project and the project itself according to environmental and health/safety rules

Annex C
(informative)

Typical actions and functions at each stage of the whole life

Table C.1 lists the stages of whole life of a building or building-related facility, and gives a list of typical actions and functions which may occur at each stage. (This list is indicative and neither comprehensive nor normative. To ease understanding of the stages, this list also includes some actions and functions which are not part of service life planning.)

There is no international consensus on what the stages, sub-stages and main tasks given in Table C.1 are. Even within the parts of ISO 15686, there is inconsistency. In other International Standards there are many varied versions of the stages of building projects and of the whole life of buildings. There is wide variation among national and regional standards, such as those published in North America and the European Union.

The lists in Table C.1 also take into account many variations on the process by which new buildings are acquired, used and owned, including differences among countries in the legal structure in which real property is owned, leased, used or constructed, and the cultural differences and levels of development among various parts of the world.

Table C.1 — Typical actions and functions during the whole life

Stage no.	Name	Task of the stage	Example of typical actions and functions at each stage
Portfolio operations			
0.1	Portfolio strategy	— Develop and maintain portfolio strategy, plans and capital project priorities	a) Create and maintain current, validated data about the portfolio, including: 1) external context and drivers of demand 2) functional requirement levels for each category of functions and each occupant group 3) relative importance of each functional requirement 4) any mandatory or minimum levels of functionality for a function or a user group 5) functional requirement levels for each asset 6) relative importance of each requirement for an asset 7) any mandatory or minimum levels of functionality for an asset 8) importance of each asset for mission, derived from the importance for mission of the function it supports, and the users it supports 9) functional capability of each asset and gaps in required capability 10) 2-D, 3-D and GIS information 11) space utilization of each asset 12) condition of each asset 13) hold appropriate data in an interoperable BIM b) Develop, maintain and update, annually, the strategy for the portfolio c) Develop, maintain and update, annually, the fiscal plan for the portfolio d) Annually update key directives e) Planning and budgeting for capital projects through the service life f) Ensure BIM is current
0.2	Portfolio requirements	— Create and maintain strategic brief for the portfolio	a) Adjust demand profile and conduct new gap analysis against rating profile of existing or proposed assets b) Identify or confirm projects in the strategy c) Draft strategic statement of requirements and business case for priority projects d) Confirm the functional requirement profile for the various segments or components of the portfolio e) Maintain BIM for each asset in the portfolio

Table C.1 — Typical actions and functions during the whole life (*continued*)

Stage no.	Name	Task of the stage	Example of typical actions and functions at each stage
Portfolio operations			
0.3	Project initiation	— Strategic brief for this project, including business and other requirements, and client's functional brief — Initiate and authorize start of project to satisfy requirements	a) Client develops demand profile for the facilities which will result from the project b) Importance of the mission(s) of the intended occupants and their importance for those missions c) Draft priorities for pending capital project(s) d) Draft and first budget for priority capital project(s) e) Develop project description f) Shift to project mode for authorized projects g) Client commits to initiate a project h) Client assigns its project leadership and project team i) Client's project leadership collaborates with portfolio and asset management team, and prospective facility managers j) Stakeholders commit to initiate a project k) Obtain authorization to launch project(s) l) Initiate BIM for the project
Pre-project stages			
1	Conception of need	— Identify potential solution options to the need and plan for feasibility — Create pre-briefing document, which includes client's general requirements	a) Client's options outlined b) Set preliminary procurement strategy c) Client's preliminary project programme or brief at general fit d) Client conducts rating of proposed facilities, which will be leased or otherwise obtained and carries out gap analysis against client's demand profile e) Ensure BIM is current
2	Feasibility	— Examine the feasibility of options presented in Stage 1 — Conduct substantive feasibility study of recommended option(s) including of procurement process — Define the project in a project brief	a) Technical project feasibility assessment b) Market analysis c) Research d) Project planning e) Budget estimation f) Preliminary economic feasibility g) Plan for project financing h) Assessment of options for procurement i) Creation of project brief j) Ensure BIM is current
3.1	Authorization	— Select procurement process — Prepare documents for approval — Gain financial approval	a) Present business case(s) b) If procurement is to be by an integrated acquisition process or design-build, compare and recommend the integrated team c) Confirm the budget and schedule

Table C.1 — Typical actions and functions during the whole life (*continued*)

Stage no.	Name	Task of the stage	Example of typical actions and functions at each stage
Pre-project stages			
3.2	First procurement	— Conduct initial procurement according to the approved process	a) Client's preliminary Project Programme or Brief b) Business case update c) Obtain authorization to proceed with the project(s) d) If procurement is to be by an integrated acquisition process or design-build, establish contract e) Project team selection f) Design/builder selection g) Construction manager selection h) Requests for qualifications i) Requests for proposals j) Interviews of team candidates k) If procurement is to be by purchase or rental, conduct the acquisition l) Ensure BIM is current
Project delivery			
4	Initial or outline conceptual design	— Create major design elements and design options based on the solution options selected	a) Client collaboration during project b) Occupant collaboration during project c) Site selection d) Site survey e) Geotechnical investigations f) Identification of major design elements based on the options presented g) Elemental cost estimate h) Outline conceptual design (also called schematic design in some localities) i) Client conducts rating of facilities proposed to be constructed and carries out gap analysis against client's demand profile j) Environmental studies k) Public consultation l) Preliminary planning approval m) Ensure BIM is current

Table C.1 — Typical actions and functions during the whole life (*continued*)

Stage no.	Name	Task of the stage	Example of typical actions and functions at each stage
Project delivery			
5.0	Preliminary design	— Do preliminary design up to start of construction design — Develop operations brief and maintenance brief	a) Client collaboration during project b) Occupant collaboration during project c) Customer's detailed project programme or brief at specific fit, typically including requirements for each specific space or room in a required facility, together with sufficient other detail to permit preliminary design and documentation for construction d) Customer's options are outlined e) Analysis of options f) Preliminary design g) Preliminary cost estimate h) Project scheduling i) Prototype design and testing j) Engineering analysis k) Detailed design development l) Material selection m) Equipment selection n) Serviceability rating of facilities proposed to be constructed and carries out gap analysis against client's demand profile o) Environmental studies p) Preliminary cost estimate q) Public consultation r) Value analysis and engineering s) Planning approval t) Ensure BIM is current
6.1	Detailed (coordinated) design	— Develop construction documents, including working drawings and detailed specifications	a) Client collaboration during project b) Occupant collaboration during project c) Detailed brief for unit spaces d) Construction data preparation e) Drawing preparation f) Detail preparation g) Fabrication drawing preparation h) Coordination drawing preparation i) Specifications preparation j) Project manual preparation k) Working drawings and specifications l) At 60 % complete, serviceability rating of facilities proposed to be constructed and gap analysis against client's demand profile m) Construction cost estimate n) Value analysis and engineering o) Permit approval p) Ensure BIM is current

Table C.1 — Typical actions and functions during the whole life (*continued*)

Stage no.	Name	Task of the stage	Example of typical actions and functions at each stage
Project delivery			
6.2	Construction procurement	— Conduct tendering and procurement of construction if not already committed in an integrated procurement process, or not a purchase or lease	a) Selection or confirmation of procurement process b) Financial approval to proceed in the selected process c) Tender documents and contract (may occur at this point) d) Prepare request for information and/or request for qualification and/or request for proposals, as appropriate e) Advertising for solicitation f) Pre-qualification g) Bid scoping h) Pricing i) Bid preparation j) Proposal preparation k) Proposal evaluation l) Bid evaluation m) Contractor selection n) Select provider team, when appropriate o) Negotiation p) Contract execution q) Depending on procurement process, actual procurement of construction might not be committed at this point r) Ensure BIM is current
7.0	Production information	— Finalize all major deliverables (e.g. electronic and other documents) and proceed to construction	a) Mobilization b) Subcontracting c) Permitting d) Regulatory review e) Regulatory approval f) Submittal processing g) Scheduling h) Coordination i) Ensure BIM is current

Table C.1 — Typical actions and functions during the whole life (*continued*)

Stage no.	Name	Task of the stage	Example of typical actions and functions at each stage
Project delivery			
8.1	Construction	— Construct the project	a) Construction start-up b) Construction may occur as a single stage (as in design-bid-build) or may occur concurrently with some of the above tasks, particularly when a single corporate entity or team both designs and builds, or designs, builds and operates c) Client collaboration during project d) Occupant collaboration during project e) If value analysis or value engineering is conducted, use the gap analysis to identify 1) potential for cost savings which lead to minimal or no impairment of functionality, and 2) needs for added investment to avoid unacceptable impairment of functionality f) When changes in the design are proposed, particularly when some parts of construction occur concurrently with some parts of design, each change should be tested for whether it enhances or impairs functionality, or is neutral g) Some months before move-in, confirm or adjust the functionality requirements profile to the extent needed to permit final furniture layouts, unit space and work station assignments to named individuals or positions, together with sufficient other detail to permit move-in h) Ensure BIM is current
8.2	Commissioning	— Prepare, fine-tune programming/briefing, conduct handover, update documentary deliverables, move-in, shakedown and verify	a) The process of commissioning starts at project inception and includes ensuring preparation for the entire service life b) When facility is substantially complete, verify that expected levels of serviceability have been achieved c) Collaboration at move-in and during commissioning d) Client's project leadership collaborates with prospective facility managers e) Handover to facility management team f) Training of operating personnel g) Initial start-up, testing and first operation h) Occupant administration of move-in i) Correction of problems found when construction is substantially complete (contractually defined milestone) j) Obtain regulatory authorization to occupy k) Facility management during move-in process l) Assessment of project process, and evaluation of compliance with all functionality requirement levels m) Rate the serviceability levels achieved, typically between six months and nine months after move-in n) Ensure BIM is current

Table C.1 — Typical actions and functions during the whole life (*continued*)

Stage no.	Name	Task of the stage	Example of typical actions and functions at each stage
Property management			
9.1	Asset operations	— Operate during initial warranty period — Operate during continued use (includes management of outsourced services)	a) Collaborate in the commissioning process b) The process of commissioning starts at project inception and includes ensuring preparation for the entire service life c) Initial start-up, testing and first operation d) Facility management during move-in process e) Day-to-day operations f) Management of facility operations g) Operating supplies and services h) Measurement on key performance indicators i) Procurement and contracting j) Quality assurance with key indicators k) Periodic market testing or retendering of selected services l) Create and maintain current, validated data about the portfolio, including: 1) external context and drivers of demand 2) functional requirement levels for each category of functions and each occupant group 3) relative importance of each functional requirement 4) any mandatory or minimum levels of functionality for a function or a user group 5) functional requirement levels for each asset 6) relative importance of each requirement for an asset 7) any mandatory or minimum levels of functionality for an asset 8) importance of each asset for mission, derived from the importance for mission of the function it supports and the users it supports 9) functional capability of each asset, and gaps in required capability 10) 2-D, 3-D and GIS information 11) space utilization of each asset 12) condition of each asset 13) hold appropriate data in an interoperable BIM 14) ensure BIM is current
9.2	Maintenance and condition management	— Maintain during use — Monitor condition — Conduct condition-related projects and other actions	a) Routine maintenance at scheduled intervals b) Maintenance special tasks and work orders c) Predictive modelling of condition d) Condition monitoring by inspection e) Maintain data on current and projected condition of major systems and components of each built asset f) Ensure BIM is current
9.3	Occupants' facility administration	— Occupants administer and use their facilities	a) Occupant administration of its facilities b) Occupant negotiation with facility managers

Table C.1 — Typical actions and functions during the whole life (*continued*)

Stage no.	Name	Task of the stage	Example of typical actions and functions at each stage
Property management			
9.4	Refurbishment, adaptation, alteration, change of use	— Provide major repairs, replacements and adaptations or alterations	a) Planning and budgeting for major repairs and alterations throughout the service life b) Draft priorities for pending major repairs and alterations c) Draft strategic statement of requirements and business case for priority projects d) Draft and first budget for major repairs and alterations e) Briefing for major repairs and alterations f) Prioritizing potential projects g) Conduct each major repair or alteration as a project having Stage 1 to Stage 8, as above h) Ensure BIM is current
9.5	Change of functional use by occupant	— Respond to client's changes in function or functional needs	a) Periodically (typically, at the time of mission or organization change, or by default at five-year cycle) ascertain, if required, levels of functionality have changed. For example: 1) client functions or operations change 2) client demand profile changes in response to changes in functions or operations 3) client develops new ways of working, with need for changed support from facilities b) Ensure BIM is current
Status change			
10.1	Disposal preparation	— Decide, plan and prepare to dispose	a) Identify need for status change, such as for disposal, decommissioning, deconstruction b) Verify compliance with strategy for portfolio and for the asset, and adjust the strategy or the decision, as needed c) May require verification of requirement profile or rating the serviceability of the facility to confirm shortfalls d) When considering possible alternative uses for a facility which can be disposed of, the serviceability profile of the facility should be compared with the requirement profiles of other potential users or categories of users, to see if there are potentially good fits e) Confirm or obtain authorization to end service life f) Ensure BIM is current
10.2	Transfer	— Dispose of title or control	a) Update plan for disposal b) Dispose of the built asset (if the facility is to be passed to other users, or put on the market for sale, then the serviceability profile can be a powerful marketing tool) c) Comply with environmental and health/safety rules d) Ensure BIM is current
10.3	Reinstatement	— Recover or reinstate	a) Identify need for recovery or reinstatement (the serviceability profile should be updated, such that it can be compared to the requirement profile of potential users) b) Ensure BIM is current

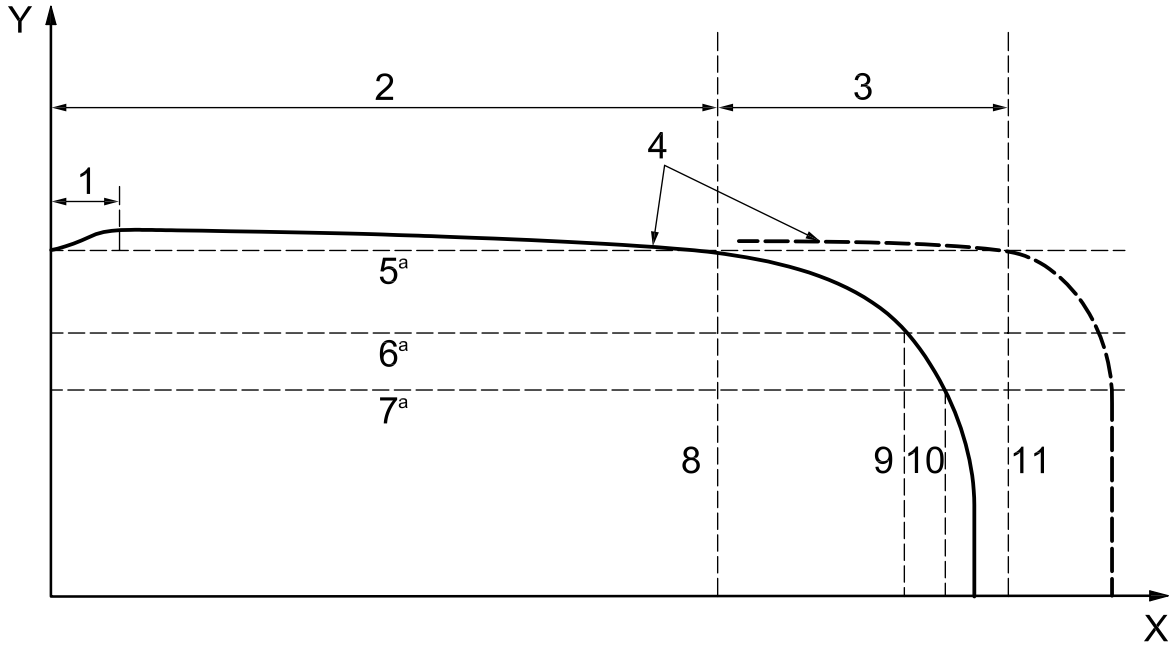
Table C.1 — Typical actions and functions during the whole life (*continued*)

Stage no.	Name	Task of the stage	Example of typical actions and functions at each stage
End of life			
10.4	Decommis-sioning	— Decommission	a) Update or prepare plan for decommissioning b) Decommission the facility c) Comply with environmental and health/safety rules
10.5	Deconstruction	— Deconstruct	a) Dismantle the built asset b) Comply with environmental and health/safety rules c) Ensure BIM is current
10.6	Recycling	— Recycling	a) Recycle the whole asset, if practicable and functional, for another use b) Recycle components of the asset, if the whole asset is not suitably recyclable c) Comply with environmental and health/safety rules d) Ensure BIM is current
10.7	Demolition	— Demolition	a) Demolish the built asset b) Comply with environmental and health/safety rules c) Ensure BIM is current

Annex D
(informative)

Consider change as well as degradation

Many forms of degradation of components or materials can impair the level of serviceability of a facility to support the operations and activities of users. A facility can be technically usable, yet become unsuitable for its intended users, if degradation results in a diminished capability to perform in support of stakeholders on some topics of functionality. For instance, degradation of cooling systems can make a factory unsuitable for certain types of manufacturing operations requiring precise control of process temperatures. This is represented in Figure D.1.



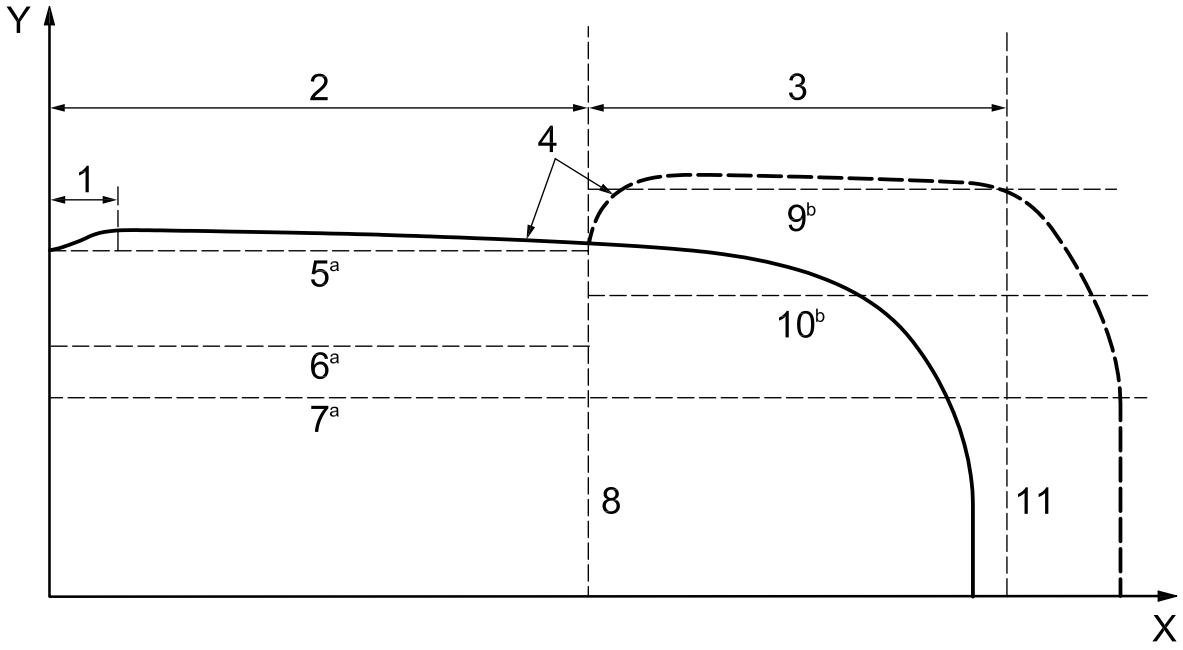
Key

X	time	6	initial threshold level[a]
Y	level	7	initial code or regulatory level[a]
1	shakedown period	8	functionality failure
2	initial planned service life	9	criticality failure
3	service life extended after repair or rehab	10	compliance failure
4	curves of progressive degradation showing repair or rehab	11	no longer functionally adequate
5	initial requirement level[a]	a	Any two, or all three, may be at the same level.

Figure D.1 — Degradation during service life

Physical degradation of some categories of building components are fairly well understood, and are discussed in other parts of ISO 15686. The generic curves in Figure D.1 might be familiar to some users of this part of ISO 15686. Figure D.2 addresses the consequences of a change in requirement levels during the service life. (In both Figure D.1 and Figure D.2, if serviceability falls below the threshold level, operations of occupants or users are significantly impaired.)

It is recommended that service life planning also explicitly consider the probability of obsolescence, that is, the probability of change in who the users are, the ways the users function at the facility, how the facility is required to support the activities and operations of users and in the loads and stresses they impose on the facility. This is represented in Figure D.2.



Key

X time
Y level
1 shakedown period
2 initial planned service life
3 service life extended after refit project to meet new requirement level
4 curves of condition or serviceability showing functionality and condition
5 initial requirement level[a]
6 initial threshold level[a]
7 initial code or regulatory level[a]
8 initial functionality failure
9 new requirement level[b]
10 new threshold level[b]
11 no longer functionally adequate

[a] Any two, or all three, may be at the same level.

[b] These two may be at the same level.

Figure D.2 — Obsolescence — Changes in requirement levels during service life

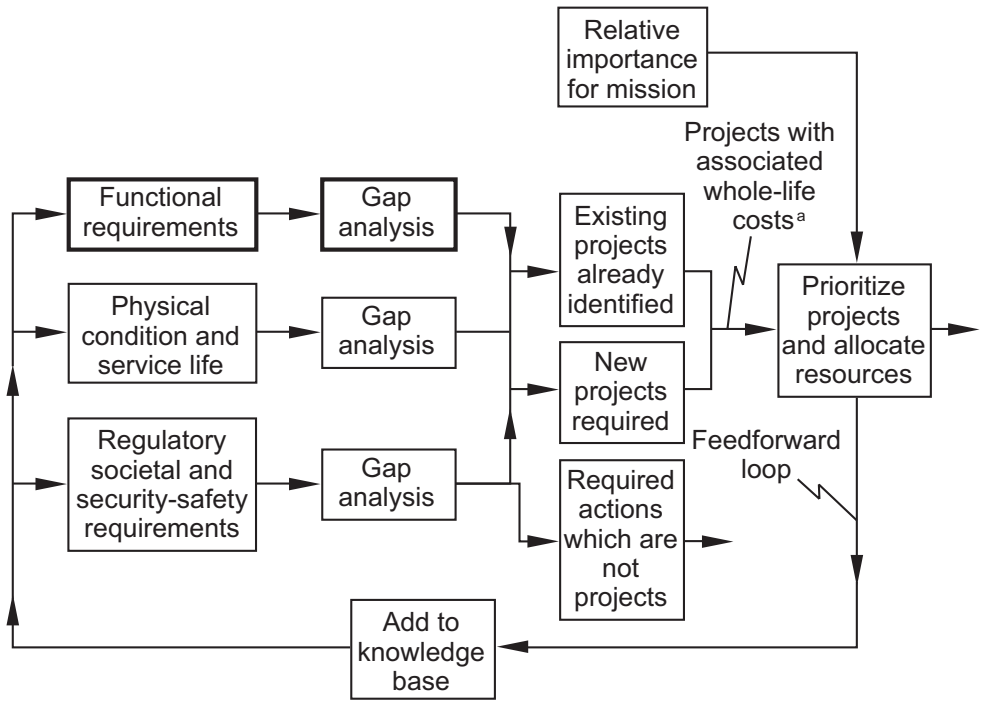
Annex E
(informative)

Tools to prioritize projects and allocate resources

Table 2 identifies the different points in time in the whole life of a building or building-related facility when the demand profile should be verified as to whether or not it is appropriate for the intended or actual use, and when the supply profile should be assessed to determine whether or not it is adequate to support such use. In this context, the demand profile provides the functional performance requirements and the supply profile describes the serviceability provided related to the capability (of the facility) to meet those functional performance requirements.

Organizations with several facilities often find that periodically they need to undertake projects to renovate or make changes to their facilities due to changes in use or in functional performance requirements. They might need to carry out major repairs, such as roof replacement, or cope with significant physical degradation of a system or component. When such projects compete for limited funding, a method is needed to rationally prioritize such potential projects. Figure E.1 gives the key elements to consider and emphasizes that functional deficiencies and relative importance of mission can often be deciding factors because the consequences of delay or failure to act can have much greater operating or financial consequences for the overall organization than for the specific physical condition of the facility involved.

For this reason, some large organizations have developed a process and mathematical formula (algorithm) for prioritizing all projects for major repair and alteration. This also incorporates potential new construction and lease changes, such that all personnel and managers affected can see the reasons, and reasonableness, of related funding decisions taken in the annual budget cycle. Such algorithms need not be complex. Indeed, simple linear equations can be used to rank the priority of each potential expenditure, such that they can be displayed as rows on a spreadsheet.



[a] Whole-life costs are defined in ISO 15685-5:2008, 3.1.14.

Figure E.1 — Functional requirements and gap analysis as part of prioritizing projects

(Source: International Centre for Facilities.)

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3) To be published.

4) To be published.

5) Under preparation.

6) Go to http://www.iai-tech.org/products/. In the Navigation column at left, select Specifications > IFC Specification > Pset Releases > Psets for IFC2×3 TC1. Under PSD files, download all PSD XML files as a single ZIP file. UnZip the file. Open the folder PSD/IfcKernel. In that folder, the property set to use is Pset_ProductRequirements.xml.

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