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Building Construction — Service Life Planning —

Part 4:
Service Life Planning using Building Information Modelling

Bâtiments et biens immobiliers construits — Conception prenant en compte la durée de vie —

Partie 4: Conception prenant en compte la durée de vie utilisant le modèle d'information du bâtiment fondée sur l'IFC

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Foreword

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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. www.iso.org/directives

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The committee responsible for this document is ISO/TC 59, *Building Construction*, Subcommittee SC 14, *Design life*.

ISO 15686 consists of the following parts, under the general title *Building Construction — Service Life Planning*:

— *Part 1: General principles and framework*

— *Part 2: Service life prediction procedures*

— *Part 3: Performance audits and reviews*

— *Part 4: Service Life Planning using Building Information Modelling*

— *Part 5: Life-cycle costing*

— *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*

— *Part 11: Terminology* [Technical Report]

Introduction

The ISO 15686 series on buildings and constructed assets, including service life planning, is an essential contribution to the development of a policy for service life planning of buildings and constructed assets.

This part of ISO 15686 establishes the basic procedures necessary for the service life planning process of buildings. However, for this to occur it is considered that an information system is needed. An information management system suitable for carrying out the service life planning process needs to meet a number of rigorous requirements including being able to

— capture enough information and support the methods needed to calculate the effect of the environment (and microclimate) on the building materials and components used,

— define maintenance schedules for different qualities of building materials installed under different environmental conditions.

— apply life cycle costing methodologies using the captured data to calculate the benefits of using either high performance materials with little maintenance or lower performance materials with better maintenance procedures. Procedures need to be able to take ease of replacement and demolition into account,

— incorporate new knowledge and predictive methods for material performance and maintenance without affecting methods and data structures that enable calculations based on current knowledge,

— support interoperability between software applications, and

— be used by designers, constructors, owners, operators and demolishers throughout the construction lifecycle.

Practically, this means applying the technology that is generally being termed Building construction Information Modelling (BIM) systems. BIM and the use of software applications that enable it is becoming a normal way of working within the construction industry. It offers significant benefits including the ability to work with construction components and assemblies as objects that encapsulate both shape (in the form of geometric information) and other information about performance, delivery, operation and more. Performance can include information about durability and sustainability metrics. This offers powerful capabilities for dealing with these key areas of interest at every level from individual component to constructed facility.

This standard is particularly concerned with the provision of information for service life planning. It proposes structures for the capture and exchange of service life planning information based on the Industry Foundation Classes (IFC) standard for information exchange and sharing and on the Construction Operations Building Information Exchange (COBie) standard.

The standard starts by providing the service life planning context within which it is prepared. Each-subsequent section covers a stage of the lifecycle of service life information, starting with its measurement and publication, followed by its adjustment in the context of a particular facility and finally its use in whole-life calculations. The annexes summarize the standard properties and provide worked examples of how the data might be used in manual or automated calculations.

Building Construction — Service Life Planning —

Part 4:
Service Life Planning using Building Information Modelling

1 Scope

This part of ISO 15686 provides information and guidance on the use of standards for information exchange for service life planning of buildings and constructed assets and their components as well as the required supporting data.

It provides guidance on structuring information from existing data sources to enable delivery of their information content in a structure that conforms to international standards for information exchange. In particular, reference is made to ISO 16739. The Construction Operations Building Information Exchange (COBie) standard for the exchange of facility information in tabular data are used as an alternative representation. COBie is a tabular representation of a handover view of the IFC schema.

It is also applicable to the exchange of service life information between categories of design and information management software applications that have standards-based information exchange interfaces including:

a) Building construction Information Modelling (BIM);

b) Computer Aided Facilities Management (CAFM).

Excluded from this part of the standard are

— information exchange using proprietary methods, and

— processing and analysis of data within individual software applications, though examples are provided.

The main target audience is the Information manager who will use the framework to assist in structuring the International, national or project/facility level BIM guidance document.

This Standard specifies the structure and representation of service life data. It is focused on key exchange requirements underlying the common transactions.

This document may be used for a variety of purposes

a) to achieve and maintain a common understanding within the national and project contexts;

b) to establish the desired outcomes and to define appropriate quality;

c) to identify appropriate management effort and tools;

d) to identify necessary effort and resourcing.

Service life planning involves the application of data about elements within a building or constructed assets to enable their design, predicted or estimated service life to be determined and communicated. Buildings are increasingly designed using Building Information Modelling (BIM), an approach that can provide a specification of all the objects in building and how they are aggregated into parts, assemblies and systems. An architect or engineer can define the objects using BIM; it is anticipated that the actor having the service life planning role will apply service life data to these objects and make the data available for other purposes through the use of data exchange standards.

Using information exchange standards to describe the structure of service life planning information is important because it normalizes the way in which service life information should be delivered from source to user so that relevant different attributes can be exchanged and a range of software applications can be used to capture the information.

1.1 Process map

The process map (see Figure 1) shows the key sequence of information exchanges and places the information exchanges in context, identifying the sending and receiving roles. It is based on the process map for design given in ISO 15686-1:2011, Annex B, and the management plan given in ISO 15686-3.

In summary, ISO 15686-2, ISO 15686-8, ISO 15686-5 and ISO 15686-7 define four processes which use service life data.

— ISO 15686-2 (Testing): Product and testing are brought together to obtain the service life characteristics.

— ISO 15686-8 (Prediction): The characteristics are brought into a specific context to obtain a predicted service life.

— ISO 15686-5 (Costing): The predicted or measured service life is used with cost or environmental impact rates to obtain a life cycle cost or assessment.

— ISO 15686-7 (In-use inspection): The context factors are revised to reflect in-use surveys.

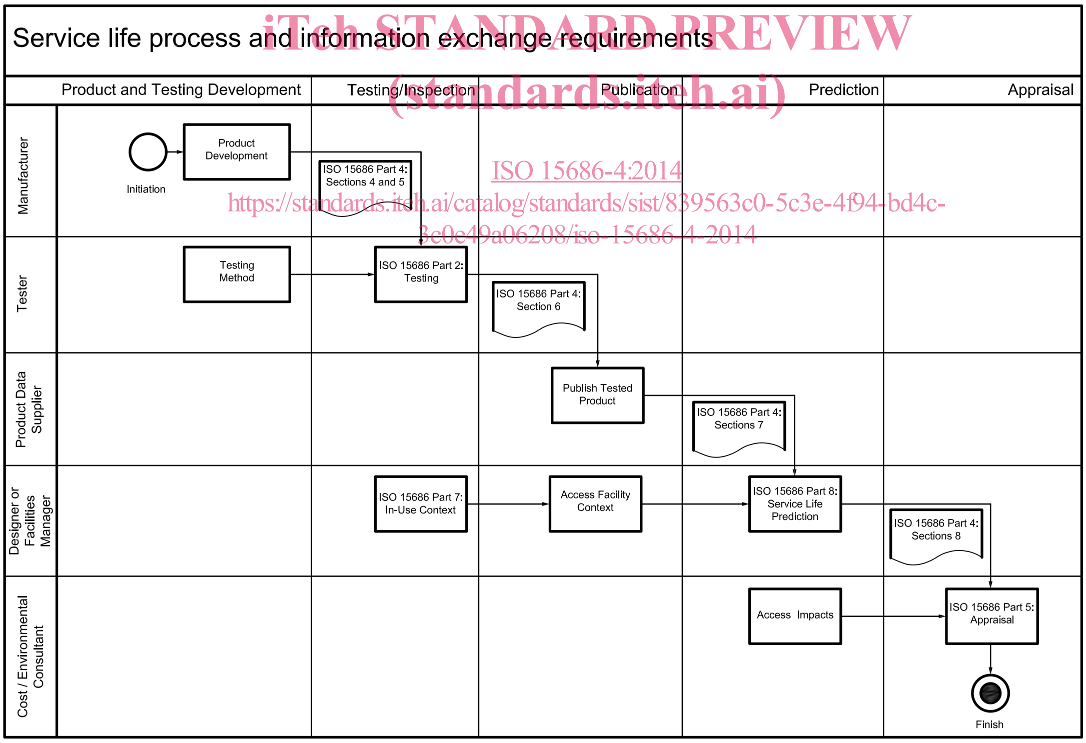

Figure 1 — Exchange requirements detailed in this part and their relationship to other parts

The process map document covers the determining of the service life of a type of product (during early design stages) and of occurrences of products of a particular type (during later design stages, construction and operation/maintenance).

NOTE The data requirements for ISO 15686-7 (In-Use inspection) are used in Clause 7 and Annex B.

1.2 Data requirements

The determination of service life is undertaken at various times during the design, construction and operation of a project. During the early design stages when product information is aggregated a level such as the whole building or as specifications of whole systems; it is only the design life of a product that can be determined. At the earliest design stages when only product occurrences are defined, design life is estimated at the occurrence level. At later design stages, when individual products are located and these products are designated by type, design life can be indicated for all occurrences at the type level. Similarly, when individual products are identified, it becomes possible to determine a reference service life when a manufacturer/supplier can be identified. As with design life, reference service life can be allocated to the product type level.

At later design stages and during construction, when the configuration and location of products has been fully established, it becomes possible to analyse the service life of products according to 'in use' conditions. These conditions can vary the reference service life depending on factors such as exposure to weather, aggressiveness of the local environment and other degrading (or upgrading) factors. The result of applying in-use conditions is to define an estimated service life which is simply the length of time of a product occurrence lifecycle.

Finally, the condition of a product occurrence can be checked from time to time during the operational stage. From the condition of the product, a residual service life can be assessed. If degradation is more than has been expected, the residual service life is reduced to less than the value that might have been expected from the estimated service life.

The overall data requirements for the process are summarized in Figure 2.

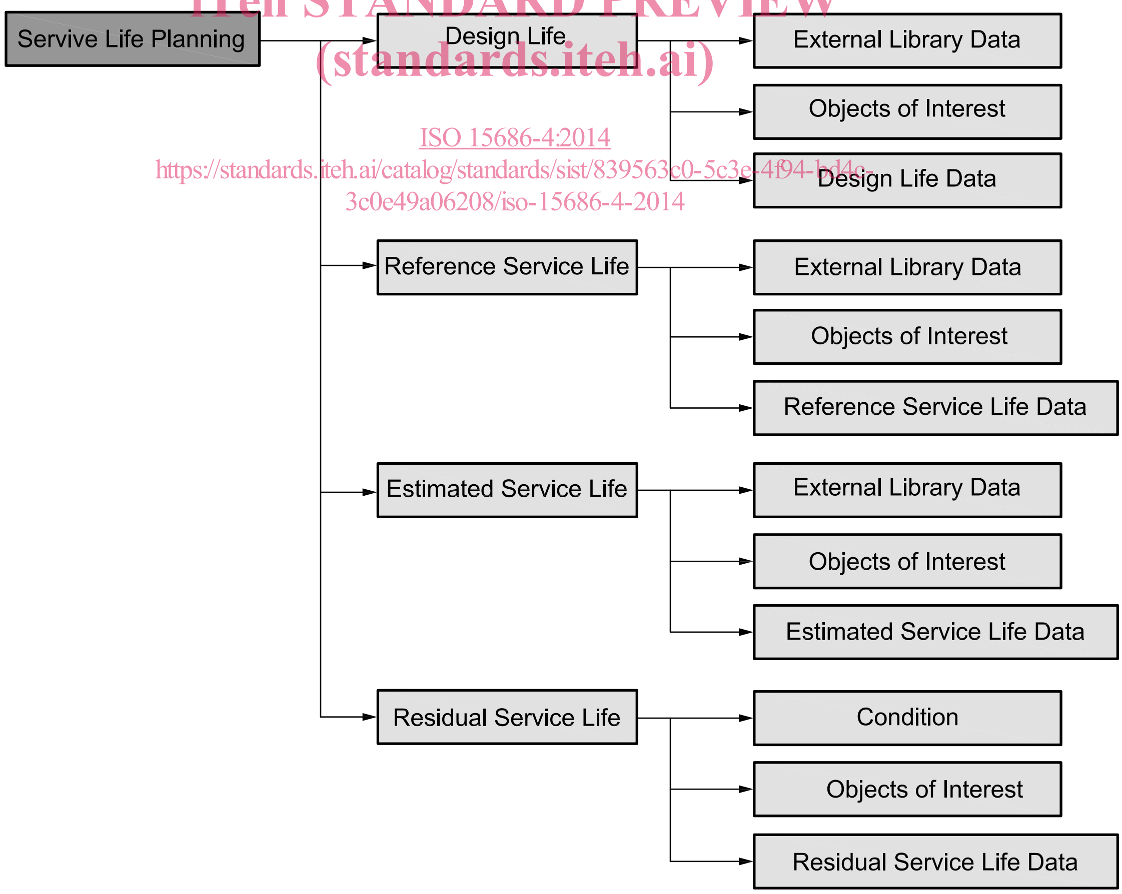

Figure 2 — The 'service life planning view'

Clause 4 of this part of ISO 15686 defines the data requirements to identify the product.

Clause 5 suggests the data required for the specification/selection of product.

Clause 6 adds the testing regimen and the key service life metrics.

Clause 7 adds the context and the predicated estimated service life.

Clause 8 adds the impacts (to date and predicted) for stages in the life cycle value.

Clause 9 suggests a representation where uncertainty and ranges of values are relevant.

Annex A provides a formal representation for Service Life definition.

Annex B provides a formal representation for Service Life factors.

Annex C provides a formal representation for Environmental and Economic Impact measures.

Annex D offers example calculations.

1.3 IFC support for service life planning

IFC contains support for a wide range of building and construction topics. The information needed for service life planning and related topics is supported by specific objects (entity types) in the schema (e.g. an object handling functional measures'), but also as general objects handling the technical performance of building components and systems, property information (e.g. material) about the building components, information about needed measures of care and maintenance etc.

There are several concepts captured in the IFC schema that are relevant to service life planning and that can be applied in a specific subset (view) of the IFC schema about service life planning. These include the following. See Table 1.

Table 1 — Concepts in IFC relevant to service life and impact assessment

Ideas in the IFC schema	*Purpose*
Service life Service life factors	Can be applied to any physical object either as a single occurrence or an aggregation or assembly of physical objects acting as a single object. A service life can have one or more related service life factors according to the ISO 15686 factor method. The term 'physical object is used here to identify the difference between an object that has physical existence as opposed to an abstract object such as a cost or constraint.
Material	A material definition can be related to a physical object
Impact	One or many economic or environmental impacts can be associated with physical product or process objects. Impacts are associated to specific stages in the life cycle.
Condition	The current condition of physical objects can be determined by applying one or more condition criteria. Condition can be determined using either subjective assessment (e.g. condition on a scale from 1 to 10 where 10 is good and 1 is bad) or by objective assessment using measured values.
Quantity sets	IFC has a capability to associate measured quantities (for example count, distance or weight measures) to an object where it is not possible to measure that quantity from the representation used or were there are specific national rules that need to be applied for quantity measurement.
Property sets	Properties are additional attributes that can be defined and captured in an IFC model. Properties are typically grouped into named collections called property sets. Property sets can be used as a basis for storing external data or for delivering data from an external data source.

2 Normative references

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

ISO 16739, *Industry Foundation Classes (IFC) for data sharing in the construction and facility management industries*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
Globally Unique Identifier
GUID
identifier given to a product that guarantees its uniqueness throughout its entire life

Note 1 to entry: Once the designed product is realized as an asset then this can be complemented with an asset tag, bar-code or other identifier.

3.2
object
unique occurrence of an item belonging to a class such that the attributes and constraints are defined by the class, having its own identity, behaviour and values for its attributes (state)

3.3
impact
representation of an economic, environmental or social dis-benefit of a product

3.4
property set
grouping of properties that belong together based on some principle, e.g. viewpoint, lifecycle stage

Note 1 to entry: See 1.2.

3.5
quantity set
grouping of characteristic measure properties

Note 1 to entry: See 1.2.

3.6
utilization ratio
proportion of time that the facility or the product is expected to be fully utilized

EXAMPLE Typically utilization will be 1,0 (100 %) for architectural fabric elements, but can be less for mechanical and electrical equipment that are used intermittently such as plant or a light bulb.

3.7
Construction Operation Buildings information exchange
COBie
representation of a handover view of the IFC schema, typically seen as a spread-sheet

Note 1 to entry: See Bibliography.

4 Product definition

4.1 General

This clause provides for the definition of a product so that the information associated can be exchanged and used. The identification of a product is central to the effective persistence of the information.

4.2 Required data

Information shall be provided for

a) the product, initially as an abstract library type and latterly as an instantiated occurrence,

b) the identity of the product, including its name, description and other properties that make it uniquely identified,

c) the source of the product, in terms of the originating organizations, author, and any reference documents, and

d) optionally, classification and grouping of the product according to local practice which aids in the searching and the reporting of the product.

4.3 Product type

Products are represented in abstract by the subtypes of IfcElementType and in use by subtypes of IfcElement. Each of these have attributes allowing selection from predefined enumerations and free text to further define the nature of the product. Typically the IfcElementType will be developed with a PredefinedType attribute. Further specialization can be given in the IfcElement's ObjectType property. See Tables 2 and 3.

Table 2 — Example product Type row in COBie

Name	CreatedBy (lookup)	Description	ExtObject (lookup)	ExtIdentifier
eAcoustical panel ceiling	info@company.com	Covering acoustical panel ceilings example	IfcCoveringType	1234567890123456789012

Table 3 — Example of a product type in IFCXML

<IfcCoveringType id=”et1”>> <GlobalId>1234567890123456789012</GlobalId> <OwnerHistory> <IfcOwnerHistory xsi:nil=”true” ref=”oh1”/> </OwnerHistory> <Name>Acoustical Panel Ceiling</Name> <Description>Covering Acoustical Panel Ceilings example</Description> <HasPropertySets> <IfcElementQuantity xsi:nil=”true” ref=”eq1”/> <IfcPropertySet xsi:nil=”true” ref=”ps1”/> </HasPropertySets> <RepresentationMaps> <IfcRepresentationMap xsi:nil=”true” href=”rm1”/> </RepresentationMaps> <Tag>Acoustical Panel Ceilings example</Tag> <PredefinedType>ceiling</PredefinedType> </IfcCoveringType>	The type, name and global identifier uniquely define the product. The ‘id’ and ‘ref’ attributes are temporary identifiers used within a model. Products have their source documented in a separate owner history object. The type is associated to both quantity and property sets. The type can have shape representations. The predefined type further defines the type.

4.4 Product occurrence

An occurrence of a product in a project uses a subtype of IfcElement. The occurrence in a building model has a placement in 2D or 3D space, and at least one shape representation. See Tables 4 and 5.

Table 4 — Example row from COBie Component sheet (selected columns)

Name	CreatedBy (lookup)	Description	TypeName (lookup)	Space (lookup)	ExtObject (lookup)	ExtIdentifeir
Acoustical panel ceiling in Room 103	info@company.com	Covering acoustical panel ceilings in Room 103	Acoustical panel ceiling	R103	IfcCovering	37N4UypQzHIfXhrSJ8E8EP