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

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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.

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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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT), see the following URL: Foreword - Supplementary information

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]

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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.

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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.

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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.

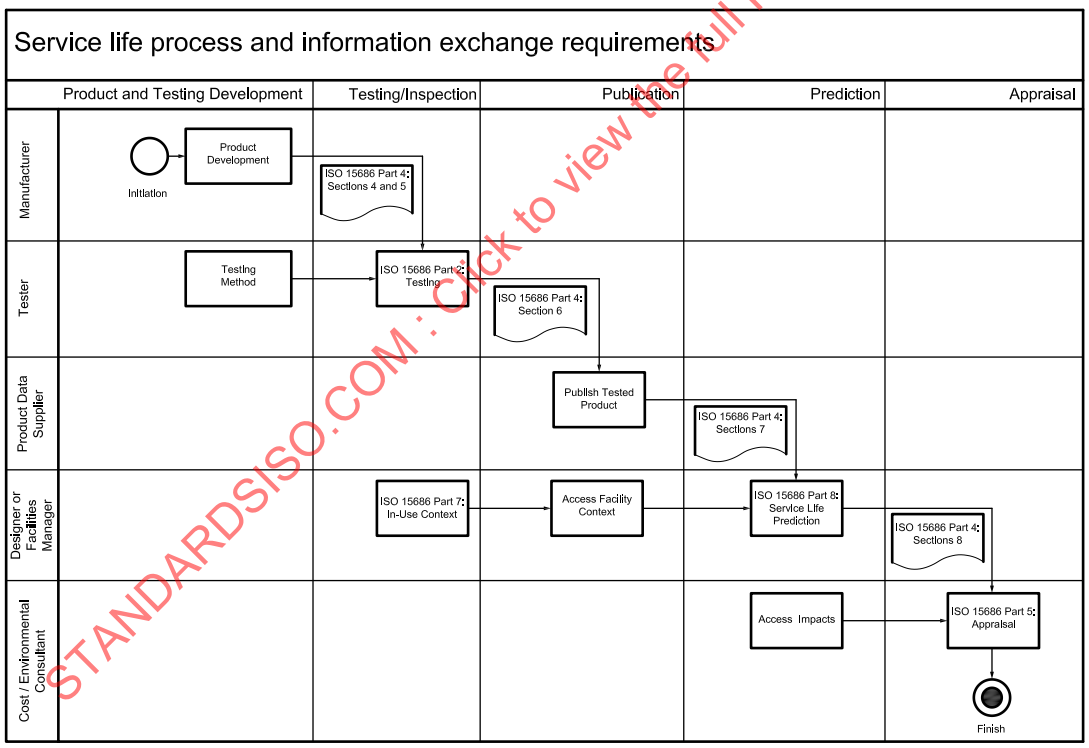

Figure 1 — Exchange requirements detailed in this part and their relationship to other parts

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.

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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.

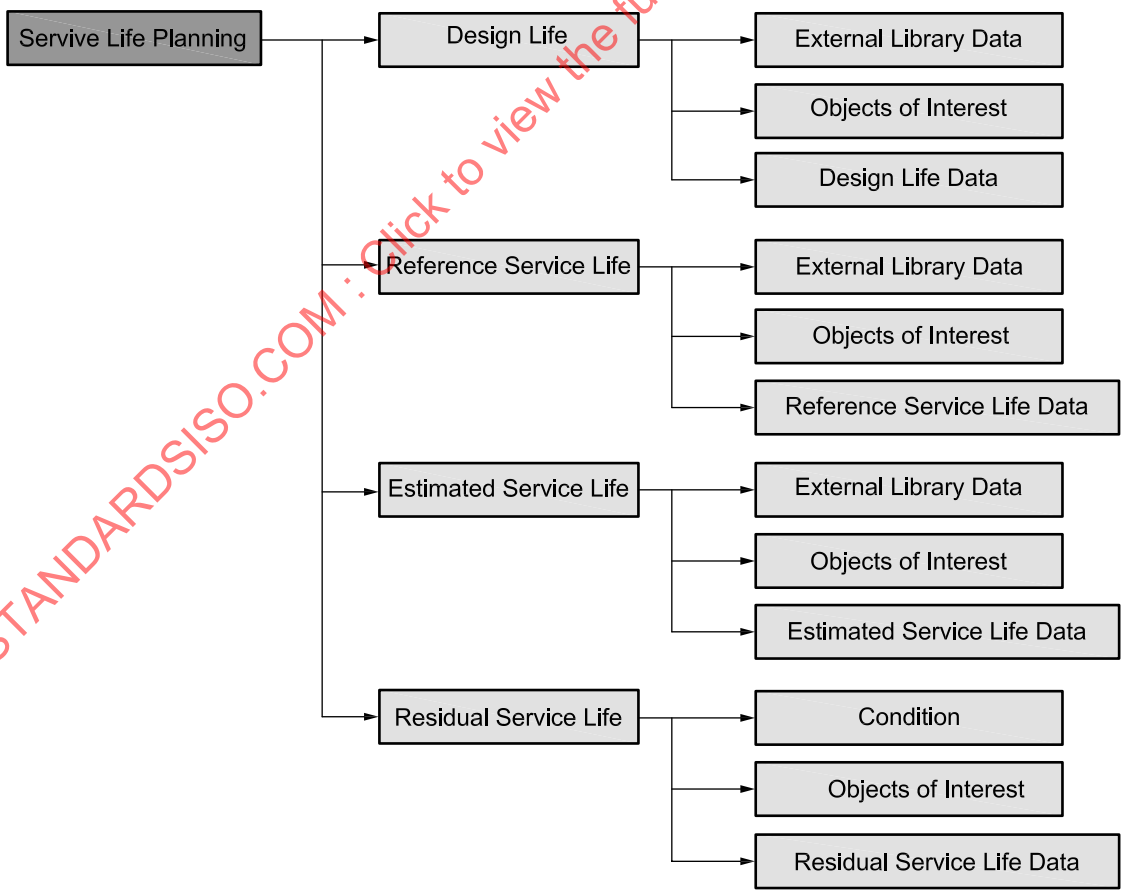

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Figure 2 — The 'service life planning view'

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

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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.

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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.

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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	123456789012345678 9012

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Table 3 — Example of a product type in IFCXML

<IfcCoveringType id="et1">> <GlobalId>12345678901234567890 12</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

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Table 5 — Example of a product occurrence in IFCXML

<IfcCovering id="e1"> <GlobalId>37N4UypQzHIfXhrSJ8E8EP</GlobalId> <OwnerHistory> <IfcOwnerHistory ref="oh1" xsi:nil="true" /> </OwnerHistory> <Name> Acoustical Panel Ceiling in Room 103</Name> <Description>Covering Acoustical Panel Ceilings in Room 103 </Description> <ObjectPlacement> <IfcLocalPlacement href="lp1" xsi:nil="true" /> </ObjectPlacement> <Representation> <IfcProductDefinitionShape ref="pds1" xsi:nil="true" /> </Representation> <ObjectType> Acoustical Panel Ceiling </ ObjectType > </IfcCovering>	The Occurrence will have shape representations and placement relative to its context in the facility.

4.5 Product origination

An owner history shall be associated to products with a definition of the authoring person and/or organization. These can have full address and contact details:

— authoring person and/or organization with role;

— application or method used;

— date created.

See Tables 6 and 7.

Table 6 — Example row from COBie Contact sheet (selected columns)

Email	Category	Company
info@company.com	manufacturer	Company

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Table 7 — Example of owner history in IFCXML

<IfcOwnerHistory id="oh1"> <OwningUser> <IfcPersonAndOrganization> <ThePerson> <IfcPerson> <Id>A.Person@Company.com</Id> <FamilyName>Person</FamilyName> <GivenName>Any</GivenName> <Roles > <IfcActorRole> <Role>userdefined</Role> <UserDefinedRole>importer</UserDefinedRole> <Description/> </IfcActorRole> </Roles> </IfcPerson> </ThePerson> <TheOrganization> <IfcOrganization> <Id>info@company.com</Id> <Name>Company</Name> <Description>Company Ltd</Description> </IfcOrganization> </TheOrganization> </IfcPersonAndOrganization> </OwningUser> <OwningApplication> <IfcApplication>	The owner history can associate a person, an organization or both to any product. It also allows the application used to capture the information to be documented. The date is represented in an integer format.

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Table 7 *(continued)*

<ApplicationDeveloper> <IfcOrganization> <Id>Organization</Id> <Name>Organization</Name> <Description> Organization Ltd </Description> </IfcOrganization> </ApplicationDeveloper> <Version>2.0</Version> <ApplicationFullName>Application 2.0</ApplicationFullName> <ApplicationIdentifier>Application</ApplicationIdentifier> </IfcApplication> </OwningApplication> <ChangeAction>created</ChangeAction> <CreationDate>1244156536</CreationDate> </IfcOwnerHistory>	

4.6 Classification

One or more classifications can be associated to a product.

— Name, source and edition of the classification system.

— Name and description of the classification entry.

See Tables 8 and 9.

Table 8 — Example of a classification entry for a product type in COBie. (selected columns)

Name	Category (lookup)
Acoustical panel ceiling	QQ1234: Ceiling coverings

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Table 9 — Example of a classification entry for a product type in IFCXML

<IfcRelAssociatesClassification > <GlobalId>12345678901234567890002</GlobalId> <OwnerHistory> <IfcOwnerHistory xsi:nil="true" ref="oh1"/> </OwnerHistory> <Name>CF2004_AcousticalPanelCeilings</Name> <Description>Classification of Acoustical Panel Ceilings according to CL 2004</Description> <RelatedObjects> <IfcCoveringType xsi:nil="true" ref="et1"/> </RelatedObjects> <RelatingClassification> <IfcClassificationReference > <Location>http://www.CF2004.com/tables#_QQ1234</Location> <ItemReference>QQ1234</ItemReference> <Name>Ceiling coverings</Name> <ReferencedSource> <IfcClassification> <Source>ClassificationFormat</Source> <Edition>2004 Edition</Edition> <EditionDate> <IfcCalendarDate> <DayComponent>15</DayComponent> <MonthComponent>11</MonthComponent> <YearComponent>2004</YearComponent> </IfcCalendarDate> </EditionDate> <Name>ClassificationFormat 2004</Name> </IfcClassification> </ReferencedSource> </IfcClassificationReference> </RelatingClassification> </IfcRelAssociatesClassification>	A relationship is created between the product type(s) and the classification entry. The classification entry can have an association to its classification system

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This subclause defines the representation of the characteristic measures of a product as a quantity set. Performance characteristics specific to its specification and selection can also be added. These characteristics are relevant to deeper searching and the construction of benchmarks and comparators.

5 Product specification and selection

5.1 General

This clause suggests representation of the characteristic measures of a product as a quantity set. It optionally suggests that performance characteristics specific to its specification and selection may also

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be added. These characteristics are relevant to deeper searching and the construction of benchmarks and comparators.

5.2 Functional measures and quantities

Information can be provided for characteristic functional measures and quantities. If no measure is given then a unit count should be assumed. In the case of materials and layered constructions, a unit volume or area should be assumed. See Tables 10 and 11.

Table 10 — Example of functional measures from COBie Attribute sheet (selected columns)

Name	Sheet Name (lookup)	Row Name (lookup)	Value	Unit (lookup)	Ext Object	Description
Volume	Type	Acoustical panel ceiling	0,018	m^3	Base quantities	Volume from product data
Area	Type	Acoustical panel ceiling	1,000	m^2	Base quantities	Nominal area for example

Table 11 — Example of functional measures for a product type in IFCXML

<IfcElementQuantity id="eq1"> <GlobalId>0IOPV0Z9vEMvZlFLUKm9EM</GlobalId> <OwnerHistory> <IfcOwnerHistory xsi:nil="true" ref="oh1"/> </OwnerHistory> <Name>Base Quantities</Name> <MethodOfMeasurement>Measurement method used </MethodOfMeasurement> <Quantities > <IfcQuantityVolume > <Name>volume</Name> <Description>Volume from product data</Description> <VolumeValue>0,018</VolumeValue> </IfcQuantityVolume> <IfcQuantityArea > <Name>area</Name> <Description>Nominal area for example</Description> <AreaValue>1,000</AreaValue> </IfcQuantityArea> </Quantities> </IfcElementQuantity>	One or more characteristic measures can be provided. Mass and Volume should be given in preference to a density

5.3 Selection and performance characteristics

Information may be provided for characteristic selection and performance properties. The selection of these properties may be specific to the type of product, the locale and the procurement method. See Tables 12 and 13.

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Table 12 — Example rows from COBie Attribute sheet (selected columns)

Name	Sheet Name (lookup)	Row Name (lookup)	Value	Unit	Ext Object	Description
Grade	Type	Acoustical panel ceiling	Grade 3		Pset_CoveringCommon	Grade

Table 13 — Example of a property set in IFCXML

<IfcPropertySet id="ps1"> <GlobalId>1hfLRDZAz8$QVWSrY4eISL</GlobalId> <OwnerHistory> <IfcOwnerHistory xsi:nil="true" ref="oh1"/> </OwnerHistory> <Name>Pset_CoveringCommon</Name> <Description>Common Properties for Coverings</Description> <HasProperties> <IfcPropertySingleValue> <Name>Grade</Name> <NominalValue> <IfcDescriptiveMeasure>Grade 3</IfcDescriptiveMeasure> </NominalValue> </IfcPropertySingleValue> </HasProperties> </IfcPropertySet>	One or more properties can be given in a property set.

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6 Product reference service life

6.1 General

This clause adds representation of the testing regime that has evaluated a product and/or the key service life metrics for use in the subsequent use cases. The authority for the metrics is documented so that the metrics can be verified by recourse to the original source.

6.2 Required data

Information shall be provided for

a) characteristics such as service life type, service life and the seven service life factors fA-fG, except where they are defaulted to 1.0, and

b) authority and documentation, which are represented using owner history attached to the property set.

6.3 Service life characteristics

See Tables 14 and 15.

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Table 14 — Example service life data in COBie Attribute sheet (selected columns)

Name	Sheet Name (lookup)	Row Name (lookup)	Value	Unit (lookup)	Ext Object	Description
ServiceLifeType	Type	Acoustical panel ceiling	REFERENCESERVICELIFE		Pset_ServiceLife	The typical service life that is quoted for an artefact under reference operating conditions.
ServiceLifeDuration	Type	Acoustical panel ceiling	24	years	Pset_ServiceLife	The length or duration of a service life
Utilization	Type	Acoustical panel ceiling	12,5	percent	Pset_ServiceLife	The proportion of time that the facility or the product is expected to be utilized.

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Table 15 — Example service life data in IFCXML

<IfcPropertySet id="ps2"> <GlobalId>2hfLRDZAz8$QVWSrY4eISL</GlobalId> <OwnerHistory> <IfcOwnerHistory xsi:nil="true" ref="oh1"/> </OwnerHistory> <Name>Pset_ServiceLife</Name> <Description> Captures the period of time that an artefact will last along with various factors that impact the expected service life. </Description> <HasProperties> <IfcPropertyEnumeratedValue> <Name>ServiceLifeType</Name> <Description> ACTUALSERVICELIFE: The service life that an asset has given. EXPECTEDSERVICELIFE: The service life that an artefact is expected to have under current operating conditions. OPTIMISTICREFERENCESERVICELIFE: The best or most optimistic estimate of service life that is quoted for an artefact under reference operating conditions. PESSIMISTICREFERENCESERVICELIFE: The least or most pessimistic estimate of service life that is quoted for an artefact under reference operating conditions. REFERENCESERVICELIFE: The typical service life that is quoted for an artefact under reference operating conditions. </Description> <EnumerationValues> <IfcLabel>REFERENCESERVICELIFE</IfcLabel> </EnumerationValues> </IfcPropertyEnumeratedValue>	The description of a property can include information about the source and confidence of that particular value. 'quality of components' is one of the seven context factors. See Annex D for the full list.

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Table 15 *(continued)*

<IfcPropertySingleValue> <Name>ServiceLifeDuration</Name> <Description>The length or duration of a service life</Description> <NominalValue> <IfcDuration-Measure>24</IfcDurationMeasure> </NominalValue> </IfcPropertySingleValue> <IfcPropertySingleValue> <Name>QualityOfComponents</Name> <Description> Adjustment of the service life resulting from the effect of the quality of components used.	
</Description> <NominalValue> <IfcPositiveRatioMeasure>1,1</PositiveRatioMeasure> </NominalValue> </IfcPropertySingleValue> <IfcPropertySingleValue> <Name>Utilization</Name> <Description> The proportion of time that the facility or the product is expected to be utilized. </Description> <NominalValue> <IfcPositiveRatioMeasure>0,125</PositiveRatioMeasure> </NominalValue> </IfcPropertySingleValue> </HasProperties> </IfcPropertySet>	

NOTE Annex A summarizes the definition of the Pset_ServiceLife.

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7 Product estimated service life

7.1 General

This clause adds representation of the context of a product and/or the predicted service life. The context is provided so that the estimate can be verified. The estimate is provided so that it can be reviewed and used in whole life value assessments. D.2 gives an example calculation.

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7.2 Required data

Data representations are provided for:

a) Predicted/estimated service life. This uses the same property set as for product reference service life (Section 6) but with the service life type set to EXPECTED SERVICE LIFE.

b) Context factors for evaluations (matching Pa-Pg). These should be associated to the product or to the nearest space, storey, building, site or project in which the product occurs, based on a n-point, typically 5 point, scale. The product utilization can also be given.

See Tables 16 and 17.

NOTE 1 The context parameters that are neutral or have no effect on service life can be omitted from this data set. A utilization of 1,0 (100 %) shall be assumed if not available.

NOTE 2 ISO 15686-8 gives guidance on the use of context factors with service life characteristics.

NOTE 3 ISO 15686-7 gives guidance on the collection of context factors from existing facilities

NOTE 4 Justification and documentation of service life data used in Environmental Product Declarations are required by EN 15804. These requirements are based on ISO 15686 series.

7.3 Context factors for evaluations

Table 16 — Example of context factors from COBie Attribute sheet (selected columns)

Name	Sheet Name (lookup)	Row Name (lookup)	Value	Ext Object	Description
QualityOfCompo-nentsGrade	Component	Acoustical panel ceiling in Room 103	LOW	Pset_Service-Life	Graded contextual effect from the quality of the components conditions.
Utilization	Component	Acoustical panel ceiling in Room 103	0.150	Pset_Service-Life	The proportion of time that the compo-nent is utilized.

NOTE Where a facility or asset is monitored over an extended period, COBie is not intended for the collection of such series data.

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Table 17 — Example of context factors in IFCXML

< IfcPropertySet id = ”ps3” > < GlobalId > 2hfLRDZAz8$QVWSrY4eISL < /GlobalId > < OwnerHistory > < IfcOwnerHistory xsi:nil = ”true” ref = ”oh1”/ > < /OwnerHistory > < Name > Pset_ServiceLifeContext < /Name > < Description > Captures the effect of the context in which a product occurs. < /Description > < HasProperties > < IfcPropertyEnumeratedValue > < Name > QualityOfComponentsGrade < /Name > < Description > Graded contextual effect from the quality of the components < /Description > < EnumerationValues > < IfcLabel > LOW < /IfcLabel > < /EnumerationValues > < /IfcPropertyEnumeratedValue > < !— etc → < IfcPropertySingleValue > < Name > Utilization < /Name > < Description > The proportion of time that the facility or the product is expected to be utilized. < /Description > < NominalValue > < IfcPositiveRatioMeasure > 0.150 < /PositiveRatioMeasure > < /NominalValue > < /IfcPropertySingleValue > < /HasProperties > < /IfcPropertySet >	

NOTE 1 Annex B summarizes the definition of the Pset_ServiceLifeContext.

NOTE 2 Where a facility or asset is monitored over an extended period, then a time series (Ifc performance history, Ifc time series) can be used to hold the data in the IFC model.

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8 Product impacts

8.1 General

This clause adds representation of the economic and environmental impacts of a product, both to-date and ongoing. Each impact must be described and the basis of any value must be supplied. Cost is generalized to be an Impact value, thereby ensuring that economic and environmental accounting can be documented. For example economic cost can be documented along with climate change measures.

These values can be used to construct aggregate values for aspects of the facility. D.3 gives an example of calculation.

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8.2 Required data

Information shall be provided for:

a) Name and description of impact with a value with unit. These properties are taken from the ISO 16739 IFC property set template Pset_EnvironmentalImpactValue. EN 15804 contains recommendations for the choice of environmental indicators.

b) Life cycle stage, with duration if applicable. These properties extend the IFC4 property set template so to specify the life cycle phase.

c) Source is documented within the owner history associated to the property set.

See Tables 18 and 19.

8.3 Impacts

Table 18 — Example of impacts for a specific phase in COBie Impact sheet (selected columns)

Name	ImpactType (lookup)	ImpactStage (lookup)	SheetName (lookup)	RowName (lookup)	Value	ImpactUnit (lookup)	LeadInTime	Duration	LeadOutTime
Global warming from maintenance of acoustical panel ceiling	Climatechange	maintenance	Type	Acoustical panel ceiling	0,800	kg	1,000	2,000	3,000

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Table 19 — Example of impacts for a specific phase in IFCXML

<IfcPropertySet id="ps4"> <GlobalId>3hfLRDZAz8$QVWSrY4eISL</GlobalId> <OwnerHistory> <IfcOwnerHistory xsi:nil="true" ref="oh1"/> </OwnerHistory> <Name>Pset_EnvironmentalImpactValues</Name> <Description>Captures environmental impact values of an element.</Description> <HasProperties> <IfcPropertySingleValue> <Name>ClimateChange</Name> <Description> Quantity of greenhouse gases emitted calculated in equivalent CO_2. </Description> <NominalValue> <IfcMassMeasure>0.800</IfcMassMeasure> </NominalValue> <Unit> <IfcSIUnit xsi:nil="true" ref="kilogram"/> </Unit> </IfcPropertySingleValue> <IfcPropertySingleValue> <Name>LeadInTime</Name> <Description> Lead in time before impact </Description> <NominalValue>	Units can be defined with the values or reference can be made to unit definitions associated to the overall model.

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Table 19 *(continued)*

<IfcDurationMeasure>1,000</IfcDurationMeasure> </NominalValue> </IfcPropertySingleValue> <IfcPropertySingleValue> <Name>Duration</Name> <Description> Duration environmental impact covers </Description> <NominalValue> <IfcDurationMeas- ure>2,000</IfcDurationMeasure> </NominalValue> </IfcPropertySingleValue> <IfcPropertySingleValue> <Name>LeadOutTime</Name> <Description> Lead out time after environmental impact </Description> <NominalValue> <IfcDurationMeas- ure>3,000</IfcDurationMeasure> </NominalValue> </IfcPropertySingleValue> <IfcPropertyEnumeratedValue> <Name>LifeCyclePhase</Name> <Description>	
The given phase for which environmental data is valid. </Description> <EnumerationValues> <IfcLabel>use</ IfcLabel> </EnumerationValues> </IfcPropertyEnumeratedValue> <IfcPropertySingleValue> <Name>Description</Name> <Description> Description of the activity during the life cycle stage <Description> <NominalValue> <IfcText>Decoration and refurbishment</IfcText> </NominalValue> </IfcPropertySingleValue> </HasProperties> </IfcPropertySet>	

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NOTE Annex C gives the definition of Pset_EnvironmentalImpactValues.

9 Representation of uncertainty

9.1 General

Predication and appraisal has inherent uncertainties attached. Where the uncertainty is significant, values should be transmitted with indication of the extent of the uncertainty.

This clause offers three alternative representations for service life and environmental values. Where a value is known either because the certainty is high or the value is given with authority, then the Ifc property single value should be used and a nominal value specified. However where the specification or testing leaves some uncertainty, the Ifc property bounded value should be used. Where there is detailed knowledge of the probable performance, an Ifc property table value should be used.

9.2 Certain data

Previous examples have used certain values, represented as an Ifc property single value. See Tables 20 and 21.

Table 20 — Example of a certain value in COBie

Name	Sheet-Name (lookup)	RowName (lookup)	Value	Unit (lookup)	ExtObject (lookup)
Climate change	Type	Acoustical panel ceiling	5,000	kg	IfcPropertySingleValue

Table 21 — Example of a certain value in IFC

```
<IfcPropertySingleValue>
        <Name>ClimateChange</Name>
<Description>
Quantity of greenhouse gases emitted calculated in equivalent CO2.
</Description>
        <NominalValue>
                <IfcMassMeasure>5,000</IfcMassMeasure>
        </NominalValue>
<Unit>
                <IfcSIUnit xsi:nil=”true” ref=”kilogram”/>
</Unit>
</IfcPropertySingleValue>
```

9.3 Uncertain data

9.3.1 Simple uncertainty

Uncertainty affecting a value can be described by the upper bound, lower bound and modal value. This approach is commonly adopted when representing informal opinions or capturing generalized experience. In the absence of further detail, it can be represented and analysed as a ‘triangular’ distribution. The triangular distribution, (see Table 22 and Figure 3) which is widely used in construction planning, is

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recommended as a working assumption for detailed calculations. To define a triangular distribution, three values should be provided:

— the modal value, being the most typical or most likely value;

— the lowest typical or likely value;

— the highest typical or likely value.

See Tables 23 and 24.

NOTE The average (mean) value can be different from the modal value.

EXAMPLE The climate change impact of an acoustic ceiling tile component is estimated as ranging between 2 kg and 10 kg, with the mostly likely value being 5 kg. The mean impact can be estimated as the average of these figures, 5.7 kg.

Table 22 — Triangular probability density table

Value	Probability density
2,000	0,000
5,000	0,250
10,000	0,000

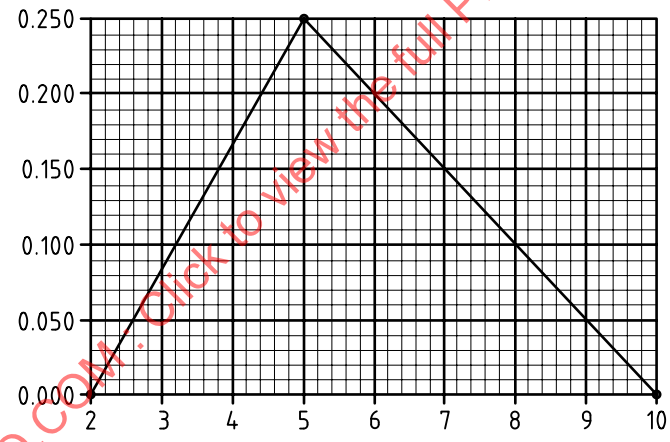

Figure 3 — Triangular probability density graph

Table 23 — Example of an uncertain value in COBie

Name	Sheet-Name (lookup)	RowName (lookup)	Value	Unit (lookup)	ExtObject (lookup)
Climate change	Type	Acoustical panel ceiling	2,000, 5,000, 10,000	kg	IfcPropertyBounded-Value

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Table 24 — Example of an uncertain value in IFC

<IfcPropertyBoundedValue > <Name> ClimateChange </Name> <Description> Quantity of greenhouse gases emitted calculated in equivalent CO_2. </Description> <UpperBoundValue > <IfcMassMeasure>10,000</IfcMassMeasure> </UpperBoundValue> <Unit> <IfcSIUnit xsi:nil="true" ref="kilogram"/> </Unit> <LowerBoundValue > <IfcMassMeasure>2,000</IfcMassMeasure> </LowerBoundValue> <SetPointValue > <IfcMassMeasure>5,000</IfcMassMeasure> </SetPointValue> </IfcPropertyBoundedValue>	The modal value, upper bound and lower bound have the same unit. The 'set point' value is used to hold the modal value.

9.3.2 Detailed uncertainty

Uncertainty affecting a value can be described using cumulative probability. This approach allows the representation of any probability distribution, including triangular and normal (Gaussian) distributions where there is sufficient data available. A cumulative probability graph shows the probability of a value (Y-axis) not exceeding a stated value (X-axis) (see Table 25, Figure 4, Tables 26 and 27).

EXAMPLE The climate change impacts of a number of acoustic ceiling tile components have been assessed and summarized.

Table 25 — Cumulative probability table

Value not exceeding kg	Cumulative probability %
2,0	0,0
3,0	7,5
4,0	22,5
5,0	47,5
6,0	67,5
7,0	82,5
8,0	92,5
9,0	97,5
10,0	100,0

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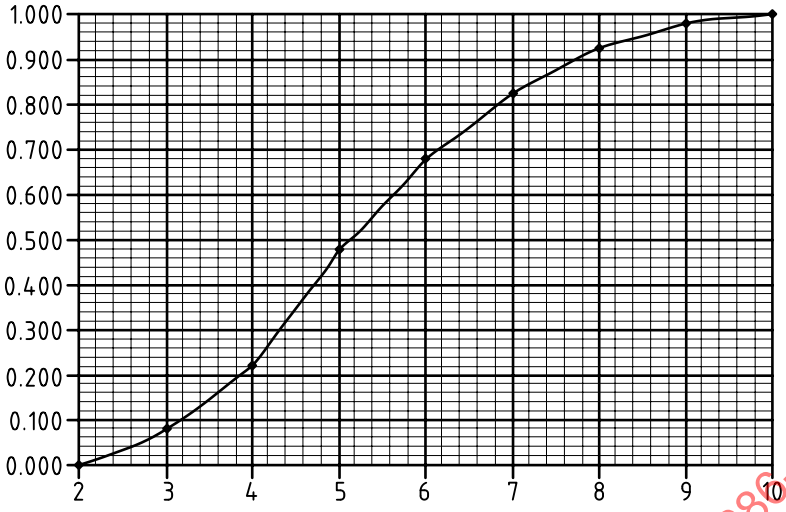

Figure 4 — Cumulative probability graph

Table 26 — Example of an uncertainty table in COBie

Name	Sheet-Name (lookup)	RowName (lookup)	Value	Unit (lookup)	ExtObject (lookup)
Climate Change	Type	Acoustical Panel Ceiling	(2,0; 0,0), (3,0; 7,5), (4,0; 22,5), (5,0; 47,5), (6,0;, 67,5), (7,0; 82,5), (8,0; 92,5), (9,0; 97,5), (10,0;100,0)	kg, percent	IfcPropertyTable-Value

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Table 27 — Example of an uncertain value in IFC

<IfcPropertyTableValue > <Name>ClimateChange</Name> <Description> Quantity of greenhouse gases emitted calculated in equivalent CO_2. </Description> <DefiningValues> <IfcMassMeasure>2,0</IfcMassMeasure> <IfcMassMeasure>3,0</IfcMassMeasure> <IfcMassMeasure>4,0</IfcMassMeasure> <IfcMassMeasure>5,0</IfcMassMeasure> <IfcMassMeasure>6,0</IfcMassMeasure> <IfcMassMeasure>7,0</IfcMassMeasure> <IfcMassMeasure>8,0</IfcMassMeasure> <IfcMassMeasure>9,0</IfcMassMeasure> <IfcMassMeasure>10,0</IfcMassMeasure> </DefiningValues> <DefinedValues> <IfcRatioMeasure>0,0</IfcRatioMeasure> <IfcRatioMeasure>7,5</IfcRatioMeasure> <IfcRatioMeasure>22,5</IfcRatioMeasure> <IfcRatioMeasure>47,5</IfcRatioMeasure> <IfcRatioMeasure>67,5</IfcRatioMeasure> <IfcRatioMeasure>82,5</IfcRatioMeasure> <IfcRatioMeasure>92,5</IfcRatioMeasure> <IfcRatioMeasure>97,5</IfcRatioMeasure> <IfcRatioMeasure>100,0</IfcRatioMeasure> </DefinedValues>	The cumulative probability table is represented by the defining and defined series, along with appropriate units. The defining values need not be evenly spaced.

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Table 27 *(continued)*

<DefiningUnit> <IfcSIUnit xsi:nil="true" ref="kilogram"/> </DefiningUnit> <DefinedUnit> <IfcConversionBasedUnit xsi:nil="true" ref="percent"/> </DefinedUnit> </IfcPropertyTableValue>	

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