TECHNICAL SPECIFICATION

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Framework for building information modelling (BIM) guidance

Cadre pour les directives de modélisation des données du bâtiment

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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.

In other circumstances, particularly when there is an urgent market requirement for such documents, a technical committee may decide to publish other types of document:

— an ISO Publicly Available Specification (ISO/PAS) represents an agreement between technical experts in an ISO working group and is accepted for publication if it is approved by more than 50 % of the members of the parent committee casting a vote;

— an ISO Technical Specification (ISO/TS) represents an agreement between the members of a technical committee and is accepted for publication if it is approved by 2/3 of the members of the committee casting a vote.

An ISO/PAS or ISO/TS is reviewed after three years in order to decide whether it will be confirmed for a further three years, revised to become an International Standard, or withdrawn. If the ISO/PAS or ISO/TS is confirmed, it is reviewed again after a further three years, at which time it must either be transformed into an International Standard or be withdrawn.

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/TS 12911 was prepared by Technical Committee ISO/TC 59, *Buildings and civil engineering works*, Subcommittee SC 13, *Organization of information about construction works*.

Framework for building information modelling (BIM) guidance

1 Scope

This Technical Specification establishes a framework for providing specifications for the commissioning of building information modelling (BIM).

This Technical Specification is applicable to any range of modelling of buildings and building-related facilities, from a portfolio of assets at a single site or multiple sites, to assets at a single small building and at any constituent system, subsystem, component or element. It is applicable to any asset type, including most infrastructure and public works, equipment and material. BIM processes are applicable across the entire life cycle of a portfolio, facility or component, which can span inception to end-of-use. The main user of the framework is the information manager, who utilizes the framework to assist in structuring an international-, national-project- or facility-level BIM guidance document. The framework can also be used for BIM guidance provided by application providers.

2 Normative references

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

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

ISO 29481-1:2010, *Building information modelling — Information delivery manual — Part 1: Methodology and format*

3 Terms and definitions

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

3.1
building information model
building (construction) information model
BIM
shared digital representation of physical and functional characteristics of any built object, including buildings, bridges, roads, process plant

NOTE 1 Adapted from ISO 29481-1:2010, definition 2.2.

NOTE 2 Building information model is frequently used as a synonym for BIM.

NOTE 3 It may form the common basis for decisions and may form the contractual point of reference, across one or more stages in the life cycle.

3.2
building information modelling
building construction information modelling
process of managing information related to the facilities and projects in order to coordinate multiple inputs and outputs, irrespective of specific implementations

NOTE BIM is the most common acronym for a broad range of methods being applied in the facilities project sector. The reference to building is historic, as the change in approach from conventional documentation is most pronounced in the building sector, but similar changes are affecting infrastructure and other facilities.

3.3
BIM guidance document
document that aids users in achieving their intended results through the use of BIM

NOTE 1 See ISO/TR 18529.

NOTE 2 BIM can aid users in discovering the capabilities of a system, enable them to generate a plan for accomplishing their goals, assist users in accomplishing a goal or help users manage error situations.

EXAMPLE Guide, guideline, manual, handbook.

3.4
IDM
information delivery manual
strategy for identifying the processes, exchange requirements, business rules and functional parts for information exchanges in facility projects

NOTE See ISO 29481-1:2010.

3.5
information model
formal model of a set of facts, concepts or instructions to meet a specific requirement

3.6
constraint
relationship between two or more elements in a model, which should be maintained in any modifications made subsequent to a model transfer

NOTE 1 See ISO 10303-108.

NOTE 2 A constraint is either an objective or a measure.

3.7
project
unique process consisting of a set of coordinated and controlled activities with start and finish dates, undertaken to achieve an objective conforming to specific requirements, including the constraints of time, cost and resources to effect change to the physical or operational aspects of a facility

NOTE Adapted from ISO 9000:2005, definition 3.4.3.

3.8
clause
subsection of a guidance document which contains an objective and one or more definitions and requirements

3.9
facility
physical structure or installation, including related site works, serving one or more main purpose

NOTE It can require management over part or all of its life cycle.

3.10
framework
structure of processes and specifications designed to support the accomplishment of a specific task

[ISO/IEEE 11073-10201:2004, definition 3.22]

3.11
measure
quantitative or qualitative assessment of relative achievement of a desired quality characteristic

NOTE 1 It is able to be tested against a descriptive model, such as a BIM or a BIM guidance document.

NOTE 2 The outcome is true, false or unknown.

3.12
objective
constraint that is measurable by examination of its constituent objectives and measures

3.13
life cycle
stages and activities spanning the life of the system from the definition of its requirements to the termination of its use, covering its conception, development, operation, maintenance support and disposal

NOTE 1 Adapted from IEC 61508 and ISO/IEC 15288:2008, definition 4.10.

NOTE 2 Adapted from ISO/TR 18529:2000, Clause 3.

4 Intentions

4.1 Intention of the framework

The construction and facilities industry is adopting the use of object-orientated methods in capturing the information about its products. This is being driven internally by demands for efficiency and externally by demands for a higher quality and value in the product. In order to maximize the return on this investment, the industry needs better structured and more re-usable performance specifications. This Technical Specification specifies a framework for providing a specification for the commissioning of BIM. The framework allows international-, national- and project-specific BIM guidance documents to be collated and partners in new projects to assimilate the practices and expectations of other partners. It is intended that supplements be merged into or appended to this Technical Specification. The objectives of the framework are the following.

a) Create a common framework giving guidance for the application of BIM:

   1) aid the development of clear and repeatable processes;

   2) allow international, national and project/enterprise guidance document to be prepared according to a common framework;

   3) allow application guidance documents to be prepared according to the same common framework.

b) Make BIM guidance documents manageable:

   1) encourage completeness of guidance documents by providing a check-list of outcomes, management and inputs;

   2) encourage the provision of reasoned explanations for demanded performance;

   3) achieve extensibility of guidance documents;

   4) support the merging and comparing of “BIM guidance” documents.

c) Make BIM guidance able to be tested:

   1) encourage the testing of guidance documents against this framework;

   2) encourage the testing of BIM usage against guidance documents;

   3) encourage the use of formal contractual clauses which refer to guidance documents.

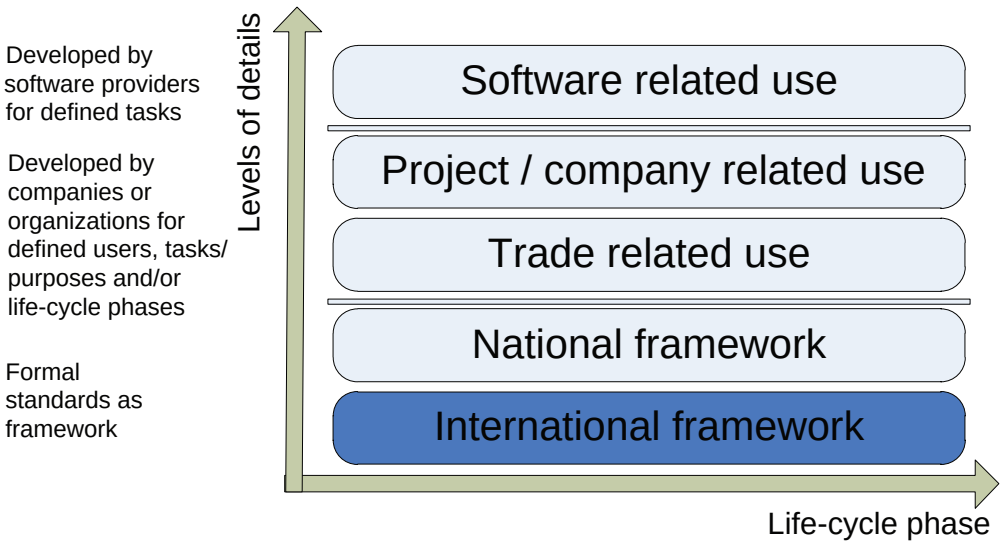


Figure 1 — BIM guidance provided at various levels

4.2 Intention of BIM guidance documents

BIM guidance documents are used for a variety of purposes, including to

a) establish the desired outcomes and define appropriate quality,

b) identify appropriate management effort and tools,

c) identify necessary effort and resourcing, and

d) achieve and maintain a common understanding within the national and project contexts.

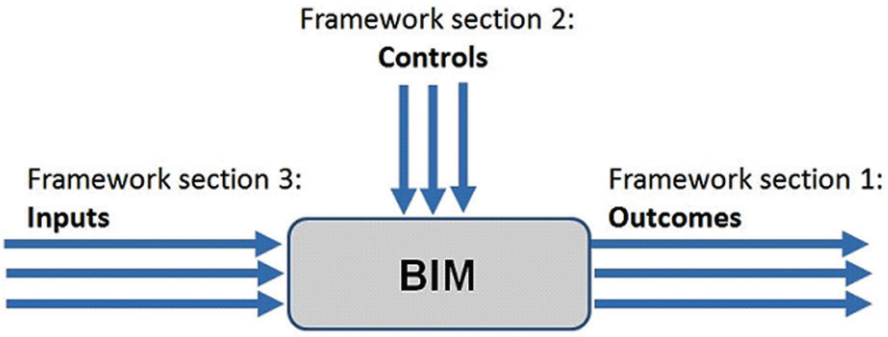
4.3 Overview of framework sections

BIM guidance documents may additionally address the presentational conventions for application in the generation of drawings and documents. This content may be carried forward from national and project drawing and document production standards.

Principals, design managers and end users should be able to easily navigate and understand any BIM guidance document that results from implementation of this Framework. The enterprise is supported when the objectives for using BIM (BIM guidance Framework section 1: Outcomes) is reviewed and approved at the principal level. Design management (BIM guidance Framework section 2: Controls) is supported by reviewing and implementing the management policies needed. Since these policies are keyed into the overall objectives, the dialogue between the design manager and the principals is supported. Design teams can review and implement the input requirements (BIM guidance Framework section 3: Controls) as this defines what they shall do. Again, since these requirements are keyed into the management policies, the dialogue between the design teams and design manager is supported.

The style and content is intended to ensure that the requirements within the guidance document are directly measurable either by human inspection or by automated checking.

A BIM guidance document may be provided at an overall project or facility level, but may also be provided more specifically for individual BIM sub-processes within those overall objectives. These individual processes may be arranged in series and in parallel. The IDM methodology (as given in ISO 29481-1) shall be used to document, review and specify new BIM processes. The outcomes of review of new processes should then be documented in the BIM guidance document, thus adhering to this framework.



NOTE BIM process: the desired results determine the required inputs and controls.

Figure 2 — Overview of framework sections in the BIM process

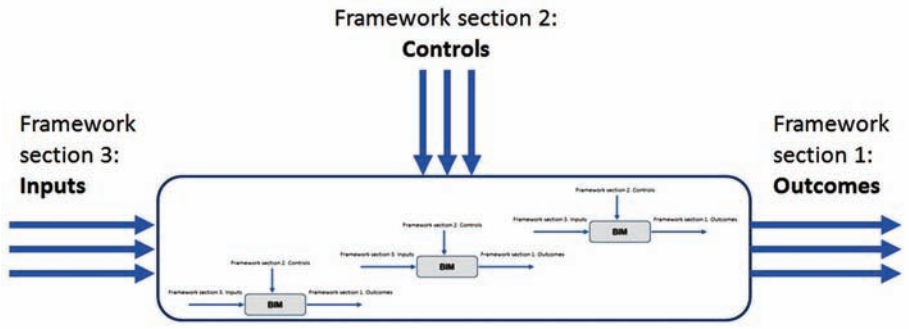


Figure 3 — Interaction of BIM subprocesses

5 Formal aspects of BIM information exchange

5.1 General recommendations

The following recommendations are intended as a checklist for the formal aspects of information exchange arising from the use of BIM a guidance document .

5.2 Delivery agreement

An agreement may be written for each process where data are exchanged between actors, for a project or a facility. The objective of the agreement is to specify the purpose, how the delivery shall be conducted and controlled and what data are to be delivered. The agreement should be harmonized with national legislation, as well as with other contractual documents. It may be included as part of a contract for a service or as an attachment to the contract. It may specify the consequences of non-fulfillment of the requirements. The agreement on information delivery/exchange should only cover this where the compensation for faults in delivered information is not covered by the main contract for the assignment.

5.3 Specification of content

The intended result (deliverables) may be specified by use of this framework. The agreement may cover how the information shall be delivered and/or stored, including:

a) file or database format;

b) data schema;

c) media or data repositories.

5.4 Acceptance

The process of checking/reviewing the information may be stated, whether by the sender and/or the receiver; the methods and tools to be used may be stated also.

5.5 Owner's rights and rights for use of information

If ownership of the information is not explicitly transferred, the agreement may allow or disallow other usage and/or modification of the information. The terms of the agreement should comply with intellectual property rights as expressed in laws and industry agreements.

5.6 Responsibility

Normally, the supplier of the information is responsible for the information fulfilling the requirements. A model may, however, contain information that is not appropriate for the purpose of the delivery. The agreement should make clear whether responsibility should include all information delivered, only a specified subset or everything except a specified subset. A model may include information supplied by several actors. It should be made clear whether one actor takes responsibility for all content or if each actor is responsible for separate contributed parts. A third option is for responsibility to be shared by the group which participated in creating the model, without pointing out specific parts.

5.7 Traceability

In order to follow up on an agreement, the entities delivered on different occasions should be recorded; communication regarding the deliveries should be recorded as well .

If responsibility for parts of an information model is divided between actors, there should also be a method for documenting the responsible actor for each part of the model and the actions/versions for each part.

5.8 Compliance

This framework is intended to support rigorous testing of compliance with the BIM guidance document. This should be achieved by inspection or by the application of automatic compliance checking configured with the content of a BIM guidance document. In either case, it is expected that:

a) every BIM object, attribute and relationship shall satisfy all of the objectives defined in Framework section 1: Outcomes;

b) the results make reference to objectives from other clauses of the document;

c) a BIM object, attribute and relationship shall satisfy an objective by showing that it is not applicable, is not selected, is excepted or is as required.

5.9 Implications of non-compliance

Compliance with the framework is intended to be tested according to Section 6. Non-compliance can impact usability of the BIM guidance document and create difficulties in the coordination of separate BIM guidance documents and so lead to contractual ambiguities.

Compliance with the BIM guidance document is intended to be tested against the levels of results, the management and the input stages documented in A.1, A.2 and A.3. Non-compliance can impact the quality and efficiency of project/facility delivery.

6 The framework for the BIM guidance document

6.1 Overview of the framework

6.1.1 General

The framework shall be mandated/adopted/applied/implemented for use by authors at international, national and project/facility levels. National bodies and organizations responsible for projects or facilities may mandate the framework and BIM guidance document produced according to it.

It shall be implemented for use in BIM guidance documents on specific facilities and projects.

The authoring conventions for International Standards should be maintained at every level of the guidance document so that titles have no effect, but the body text shall be normative, including the invocation of other clauses. It shall be possible to test every framework section.

The guidance document shall be divided into three sections or areas; for BIM Sections 1 to 3, see Figure 2. For additional details, see Annex A.

6.1.2 Framework section 1: Outcomes

The outcomes section shall provide guidance for the specification of the desired results.

The content may be derived from the IDM process and exchange requirement deliverables or other documents defining the structure and content of the desired results.

6.1.3 Framework section 2: Controls

The controls section shall provide guidance for the specification of managerial processes and quality assessment associated with the process of BIM.

The content may be derived from the IDM validation rules and business rules deliverables or other documents defining the constraints on the desired results.

6.1.4 Framework section 3: Input

The input section shall provide guidance for the specification of the inputs required to achieve the aims selected in Framework section 1: Outcomes and the managerial processes required by Framework section 2: Controls.

The content may be derived from the IDM functional parts and concepts, deliverables or other documents defining units of information necessary for the desired results.

6.2 Integrity

The fundamental structure of the framework shall be maintained.

The fundamental structure of the framework makes certain that there is consistency and compatibility between guidance documents. This ensures that each BIM process can be developed, approved and implemented at the appropriate level of management and responsibility, and ensures that similar clauses can be easily located and reviewed.

The following features are required.

a) The guidance document shall be organized into three framework sections, relating to the desired outcomes, controls and inputs.

b) Decimal numbering shall be used and each clause shall have a title. There shall be further subdivisions as indicated in Annex A.

c) The ordering and numbering of the clauses shall be maintained.

d) Three levels of guidance shall be distinguished:

   1) international clauses shall be entitled "Common ... " and their numbers given the suffix "A";

   2) nationally and regionally mandated policies shall be entitled "National ... " and their numbers given the suffix "B". This may include guidance provided by professions and associations;

   3) project- and facility-specific implementations shall be entitled "Specific ..." and their numbers given the suffix "C". This may include guidance provided with specific applications and implementation conventions, including owners or corporate policies.

e) every reference to a clause shall correspond to a clause appearing later.

6.3 Extensions

The integrity of the framework, as defined in 6.2, shall be maintained when the guidance document is

a) expanded by the insertion of additional clauses at the end of the existing framework sections or by the subdivision of a framework section,

b) translated into other languages, or

c) trimmed (filleted) to suppress clauses not relevant to specific implementation.

A guidance document, being an implementation of this framework, may suppress (sub)clauses within sections and/or add additional clauses. It may not suppress any of the three framework sections. it is possible for future revisions of this Technical Specification to incorporate additional clauses to reflect the increasing scope of the application of BIM.

6.4 Clauses

Clauses, being the "leaf terminal subsections" of the guidance document, shall be written in order to express the normative objective by the clear expression of requirements, exceptions, applicability and selection.

6.4.1 Objective

Every clause shall have an objective which summarizes the intention and implies the impact of non-compliance.

6.4.2 Applicability

Every clause shall identify the scope of application. This shall be one or more measures, which progressively focus on the objects relevant to the objective.

6.4.3 Selections

Any clause may identify the scope of selection. This may be one or more measures, which collectively widen the focus of objects relevant to the objective.

6.4.4 Exceptions

Any clause may identify the exceptions to the scope. This may be one or more alternative measures, which eliminate objects as not relevant to the objective.

6.4.5 Requirements

Every clause shall identify the requirements and/or definitions. This may be one or more measures that individually constrain the objects to fulfil the objectives.

Definitions are specialized requirements which extend or amend the contents of the BIM, and consequently cannot be unfulfilled.

EXAMPLE A definition of "architectural" can imply a named grouping of wall, slab door and window objects.

7 Relationships with other International Standards

7.1 Review

This Technical Specification should be the primary reference for entities specifying and providing BIM services. It can be supplemented by International Standards which address specific areas such as:

a) the development of new areas of application (see ISO 29481-1, which is referred to in short form as the: "IDM standard");

b) specialized application areas, such as service life planning [see ISO 15686 (all parts)];

c) schemas for facility data:

   1) ISO 16739;

   2) ISO 15926 (all parts) for process plants;

   3) CIS/2 for structural steel;

d) classification structures and language usage:

   1) ISO 12006-2;

   2) ISO 12006-3 (referred to in short form as the: "IFD l standard").

7.2 Development of new areas of application

Where new outcomes are envisaged, it is recommended that ISO 29481-1 be applied. The inputs into the IDM process include a detailed process map, highlighting the interfaces between parties and documenting the information requirements. Business rules that constrain the expected data, may be detected. The outcome is a schedule of functional requirements, which may have a correspondence with functionality in specific applications or with representations in specific interoperability. In general, the exchange requirement may generate a new subclause in Framework section 1: Outcomes, business rules may generate new subclauses in Framework section 2: Controls, and functional parts may generate new subclauses in Framework section 3: Inputs.

7.3 Specialized application areas

Specialized application areas may be described in other International Standards. The implications of these International Standards may be inserted into the developed BIM guidance report by domain experts. Future International Standards may include clauses for insertion into the developed BIM guidance report.

NOTE Development of BIM guidance reports must look at other relevant standards to be functional within specialized application areas. This document covers the general framework.

7.4 Schemas for facility information

Where the input, management and results are handled in different applications or in different locations and timeframes, interoperable schemas may be used. Such schemas also offer a common ontology independent of applications and domain terms.

7.5 Classification structures and language usage

Historically, the facility industry has deployed a wide variety of classification structures over its physical and process domains. Their acceptance can be limited geographically and by domain. The framework recommends the use of the ISO 12006-2 schedule of classification tables. National and project level implementation should refer to completed versions of these tables.

Where language and usage of key concepts diverge, it is recommended that the IFD resources be deployed to support automatic resolution of terminology.

Annex A
(normative)

Guidance on building information modelling

A.1 Framework section 1: Outcomes

The information in this annex shall be required of the application of BIM to the facility/project.

Extend or delete as applicable, while complying with Clause 6.

BIM Section 1 contains a list of the possible desired results to be obtained from the application of BIM. Its content may be derived directly from demands or from the review of IDM exchange requirements or other requirement documents.

The results in Table A.1 shall be obtained.

Table A.1 — Framework section 1: Outcomes

Reference to subclause(s) of BIM guidance document	Item	Comment/note
1.1	Outputs	The range and scope of the desired outputs has a direct impact on the required management and inputs.
1.1.1	Documents	For integration with conventional methods, including remote use, BIM may be required to generate conventional documents for electronic or physical use. These are effectively reports or "information take-offs". Some key types of document are identified in 1.1.1.1 to 1.1.1.3.3.
1.1.1.1	Drawings	
1.1.1.1.1	Project/facility (product) level	
1.1.1.1.2	Assembly level	
1.1.1.1.3	Detail and component level	
1.1.1.2	Reports	
1.1.1.2.1	Schedules of instances	
1.1.1.2.2	Schedules of groups	
1.1.1.3	Visualization (realistic/ thematic)	
1.1.1.3.1	Static	
1.1.1.3.2	Motion picture/film	
1.1.1.3.2.1	Fly-through and walk-through	
1.1.1.3.2.2	Animation	
1.1.1.3.2.2.1	Design logic	
1.1.1.3.2.2.2	Construction/demolition sequence	
1.1.1.3.2.2.3	In-use	

Table A.1 *(continued)*

Reference to subclause(s) of BIM guidance document	Item	Comment/note
1.1.1.3.3	Virtual reality (VR)/ augmented reality (AR) experience	
1.1.2	Messages	The application of BIM can lead to the identification of issues that require resolution or risks, which should be documented and managed for as long as they remain unresolved. If these messages are generated, a single common management process should be in place to handle them. Red underlining and mark-up are examples. 1.1.2.1 and 1.1.2.2 identify some key types of message.
1.1.2.1	Issues	Issues include foreseen failures and incompatibilities.
1.1.2.2	Risks	Risks include uncertain outcomes and impacts.
1.2	Outcomes/achieved states	The outcome of the application of BIM may be the achievement of a new state of compliance or certification for the project/ facility. 1.2.1 and 1.2.2 identify some key types of outcome.
1.2.1	Compliance	
1.2.1.1	Coordination and spatial strategy	Clash elimination relates to the physical location of products, whereas interference elimination takes into account the operational requirements of the products and users.
1.2.1.1.1	Clash elimination	
1.2.1.1.2	Interference elimination	
1.2.1.2	Requirements compliance	
1.2.1.3	Regulatory compliance	
1.2.1.4	Advisory compliance	
1.2.2	Certification	
1.2.2.1	Functional certification	
1.2.2.2	Legal certification	
1.2.2.3	Warranty	
1.3	Analysis and simulation	The BIM may be required to support the technical analysis of the facility/project. The subclauses identify a number of types of analysis which may be applied. The list is not exhaustive and can be extended by addition to or subdivision of the subclauses.
1.3.1	Functional	
1.3.1.1	Operational	
1.3.1.1.1	Spatial measurement	
1.3.1.1.2	Movement and accessibility	
1.3.1.1.3	Thermal	
1.3.1.1.4	Light	
1.3.1.1.5	Acoustic	
1.3.1.1.6	Air, including fire smoke and pollutants	
1.3.1.2	Cost and time	
1.3.1.2.1	Quantity take off (QTO) and measurement	

Table A.1 *(continued)*

Reference to subclause(s) of BIM guidance document	Item	Comment/note
1.3.1.2.2	Quantity take off report	
1.3.1.2.3	Time-based analysis	
1.3.1.3	Structural	
1.3.1.3.1	Static load cases	
1.3.1.3.2	Dynamic load cases	
1.3.1.4	Environmental	
1.3.1.4.1	Energy use	
1.3.1.4.2	Resource use	
1.3.1.4.3	Other impacts	
1.3.1.5	Social	
1.3.1.5.1	Health	
1.3.1.5.2	Well-being	
1.3.1.5.3	Community	
1.3.2	Multiple assessments	
1.4	Integration	The outcome of the application of the BIM may be the integration of the information with other processes or products.
1.4.1	Approvals	
1.4.2	Procurement	
1.4.3	Operations	
1.4.3.1	Building controllers	
1.4.3.2	Handover	
1.4.3.2.1	Operational handover	
1.4.3.2.2	Maintenance handover	

A.2 Framework section 2: Controls

BIM Section 2 contains a list of the possible management approaches which can be applied to BIM. In general, they represent supportive activity which does not result in any physical expression. The content of the approach may be amplified directly or from the review of formal methods, such as the IDM validation and business rules.

The management tools and processes in Table A.2 shall be applied.

Table A.2 — Framework section 2: Controls

Reference to subclause(s) of BIM guidance document	Item	Comment/note
2.1	Facility and project life-cycle stages/phases	Stages and phases are valuable in creating clear milestones where benchmark review and comparisons of progress and resourcing can be carried out. If there are several nomenclatures, these should be aligned in this subclause. Reference can be made to the generic process protocol in the IDM, which provides a default nomenclature which may be refined at the national and project/facility level.
2.2	Integrity	Processes may be required to check the integrity of the data sets. This may include the checking of file validity using applications or the checking of specific business rules.
2.2.1	File integrity	
2.2.2	Schema compliance and validation	
2.2.3	Data quality and business rule compliance	
2.3	Completeness	Processes may be required to check the completeness of the data sets. These may require that all objects be developed on the same level and also specify the level. Levels may be defined for specific levels of service, and/or for specific stages. The level may specify the scope for semantic content, information and/or geometry. Inclusions and exclusions may be needed to adequately define completeness.
2.3.1	Semantic levels	
2.3.1.1	Elemental and system schedule	
2.3.1.2	Object-type schedule	
2.3.2	Information levels	Definition of the levels of information required needs to cover both the degree of disaggregation and the amount of attribution associated with the parts of the facility.
2.3.2.1	Disaggregation	
2.3.2.2	Properties	
2.3.3	Levels of shape and positioning	Definition of the levels of detail required needs to cover the types of geometry needed, the amount of detail and any expectations for model accuracy and tolerances.
2.3.3.1	Types of geometry	
2.3.3.2	Detail	
2.3.3.3	Accuracy	
2.4	Change management	Processes may be required to manage model development and changes. In some environments, this may involve various formal access rights, the escalation of issues and risks, the logging of versions and differences, and the assignment of a developing status to the data set. BS 1192 offers a detailed approach adopted in the UK.
2.4.1	User competence	
2.4.1.1	Role	
2.4.1.2	Capability	

Table A.2 *(continued)*

Reference to subclause(s) of BIM guidance document	Item	Comment/note
2.4.2	Access rights and filters	
2.4.2.1	Read	
2.4.2.2	Update	
2.4.2.3	Write	
2.4.2.4	Delete	
2.4.2.5	Import and merge	
2.4.2.6	Export and filter	
2.4.3	Issues and risks	
2.4.4	Versioning and differencing	
2.4.5	Status	
2.5	Workflow	Processes may be required to manage the overall workflow and the release of tasks on the completion of reviews, etc. BS 1192 details a tested approach.
2.5.1	Planning	
2.5.2	Coordination	
2.5.3	Review	
2.5.4	Approval	
2.5.5	Authorization	
2.5.6	As-delivered/as-built	
2.6	Interoperability: exchange management	Interoperability may be required as being a required outcome or necessary input. While management on both sides should apply their management tools, specific requirements may be placed on the export and import processes.
2.6.1	Export and filtering	This may involve a check-out step and may be supplemented with process compliance checking.
2.6.2	Import and merging	This may involve a check-in step and may be supplemented with process compliance checking.
2.7	Relationship to documentation	The BIM may need to maintain a formal relationship with other documents. Examples can include relationships to contractual and requirement documents, and downstream to the use of controlled derived and uncontrolled material. Metadata on documents should identify model source and version and status [see ISO/IEC 82045 (all parts)].
2.7.1	Legal and contracts	
2.7.2	Design documents	
2.7.2.1	Links/derived documents	
2.7.2.2	Unlinked documents	

A.3 Framework section 3: Inputs

BIM Section 3 gives a list of the possible inputs to BIM. In general, they represent the productive effort required. The list should correlate with the definition of completeness defined by the management approach. The content may be derived directly or from formal methods, such as IDM Functional parts and concepts.

The inputs in Table A.3 are required.

Table A.3 — Framework section 3: Inputs

Reference to subclause(s) of BIM guidance document	Item	Comment/note
3.1	Objects	This section specifies the objects to be used.
3.1.1	Elements and types	A catalogue of types which are subsequently instantiated as elements can be used to manage the facility throughout the life cycle.
3.1.2	Spatial structure and Functions	Similarly, a catalogue of functions which are subsequently instantiated as spaces can be used to manage the facility throughout the life cycle.
3.1.2.1	Facility/project	
3.1.2.2	Levels and spaces	
3.1.3	Processes and process types	Similarly, a catalogue of process types which are subsequently instantiated as processes can be used to manage the facility through construction and operation.
3.1.4		Resources
3.1.4.1	Object libraries	Catalogues of types can be agreed and re-used.
3.1.4.2	Analysis factors	Factors representing externalities can be included in the analysis.
3.1.4.2.1	Costs	
3.1.4.2.2	Productivity	
3.1.4.2.3	Impacts	
3.1.4.3	Units	Units may need to be defined
3.1.4.3.1	Length	
3.1.4.3.2	Time	
3.1.4.3.3	Others	
3.2	Attributes	This section specifies the attributes to be defined. Many attributes are managed by the applications automatically; only those required and therefore needing active attention need be specified.
3.2.1		Identification
3.2.1.1	Object	
3.2.1.2	Naming and description	
3.2.1.3	Global identifiers	The following two types of global identifiers differ. While the object instance globally unique identifier (GUID) identifies one particular wall or door in a BIM, the IFD or type GUID identifies the type.
3.2.1.3.1	Occurrence of a concept	Most BIM schemas offer some kind of GUID to identify the objects and/or property instances in the project. The global identifier plays a crucial role in the exchange of data as it allows tracking objects in a BIM across applications and time. While naming of objects can change during the lifetime of a BIM, the GUID should never change.
3.2.1.3.2	The concept or type	In a similar way, global identifiers can be used in addition to naming to ensure that exchange of information that today depends on user-defined naming becomes interoperable across systems. IFD library offers such a mechanism.

Table A.3 *(continued)*

Reference to subclause(s) of BIM guidance document	Item	Comment/note
3.2.1.4	Ownership	
3.2.2	Grouping	Design processes may use many grouping methods. Any that are critical should be documented.
3.2.2.1	Zones and systems	
3.2.2.2	External references	The scope of elements to be classified, indexed to external libraries and associated with external documentation should be defined.
3.2.2.2.1	Classification	
3.2.2.2.2	Library resources	
3.2.2.2.3	Documentation	
3.2.3	Representation	Expectations on the use of representations should be documented.
3.2.3.1	Position	
3.2.3.1.1	Geo-location and orientation	
3.2.3.1.2	Regions and addressing	
3.2.3.2	Extent	
3.2.3.2.1	Spatial	
3.2.3.2.2	Temporal	
3.2.3.3	Shape	
3.2.3.4	Symbol	
3.2.3.5	Action	
3.2.4	Other properties	Expectations on the use of properties should be documented.
3.2.4.1	Descriptive	
3.2.4.2	Quantification	
3.2.4.3	Specification and selection properties	
3.2.4.4	Performance and simulation properties	
3.2.4.5	Warranty	
3.3	Relationships	Some relationships between objects may be implicitly created, detected and maintained by applications without direct user input. Others may need to be generated on demand. Some relationships may not be handled by some applications
3.3.1	Aggregation/decomposition	
3.3.2	Containment	
3.3.3	Adjacency and proximity	
3.3.4	Association	
3.3.4.1	Of jobs to type	
3.3.4.2	Of spares to type	
3.3.4.3	Of skills to job	

Annex B
(informative)

Example of guidance on building information modelling for architectural quantity take off (QTO) report

B.1 Framework section 1: Outcomes

B.1.1 Common quantity take off (QTO) report

The information in this annex shall be required of the application of BIM to the facility/project in order to enable architectural quantity take off (QTO) reports.

This example is intended to show how a relatively simple required result can be expressed concisely and then expanded to cover the controls and inputs required to deliver that result. Any BIM guidance document should be reviewed prior to its application to a live project.

No endorsement of any standard, method or classification is implied by the example presented in this annex.

The expected results should be defined and agreed so that the necessary controls and inputs can be determined.

The outputs and outcomes in Table B.1 shall be obtained for the project.

Table B.1 — Common quantity take off (QTO) reports

Reference to subclause(s) of BIM guidance document	Item	Comment/note
1.3.1.2.1.A	Common quantity take off (QTO) reports	Information on QTO shall be obtained at the level (of information) specified in [2.3.2.A Common geometric measurements] on components as specified in [2.3.1.C Specific architectural systems]. Identification of elements shall be to [3.2.1.A Common naming of elements]. Grouping of elements shall be by type as specified in [3.2.2.A Common grouping by type and construction] and by their classification to [2.3.1.B National classification of work sections].
NOTE See Annex A for the clause numbering and the use of the A, B and C suffixes.		

B.1.2 National quantity take off (QTO) reports

The expected results should be defined and agreed so that the necessary controls and inputs can be determined.

The outputs and outcomes in Table B.2 shall be obtained for the project.

Table B.2 — National quantity take off (QTO) reports

Reference to subclause(s) of BIM guidance document	Item	Comment/note
1.3.1.2.1.B	National quantity take off (QTO) reports	Classification according to 2.3.1.B National classification of work sections shall be applied.
NOTE See Annex A for the clause numbering and the use of the A, B and C suffixes.		

B.2 Framework section 2: Controls

The controls section is used to indicate the management and other overheads needed to obtain the results. The sections may occur in other BIM guidance documents in effect, thereby reducing the relative overhead.

Table B.3 — Framework section 2: Controls

Reference to subclause(s) of BIM guidance document	Item	Comment/note
2.3.2.A	Common geometric measurements	The following geometric measurements shall be available from the elements: — net volume after deductions for openings; — net surface area with adjustment for openings.
2.3.1.C	Specific architectural systems	The following shall be managed as “architectural systems”: a) substructure; b) structural columns beams; c) structural and non-structural floors, slabs and roofs; d) stairs, ramps and shafts; e) envelope with doors and windows; f) internal divisions and doors; g) fitted furniture and sanitary fittings.
2.3.1.B	National classification of work sections	The following classification system shall be applied as a [3.2.3.A Common grouping by classification]: CSI Masterformat 2004.

B.3 Framework section 3: Inputs

The inputs section is used to indicate the direct input needed to obtain the results. The sections may occur in other BIM guidance documents in effect, thereby reducing the relative effort required.

Table B.4 — Framework section 3: Inputs

Reference to subclause(s) of BIM guidance document	Item	Comment/note
3.2.1.A	Common naming of elements	Unique readable names shall be applied to elements.
3.2.1.C	Specific naming policy	Element names shall be based on their type and a sequential number starting at 001.
3.2.2.A	Common grouping by type and construction	All elements sharing a common type or construction specification shall be associated by a single named object.

Table B.4 *(continued)*

Reference to subclause(s) of BIM guidance document	Item	Comment/note
3.2.2.C	National grouping by type and Construction	Wall and slabs shall be grouped as: “Guidance on major construction element naming policy, 2010”, for example “Type 5A external wall construction”.
3.2.3.A	Common grouping by classification	All elements shall be classified using one or more classification systems, but only one value per system shall be used.

Annex C
(informative)

Example using structured clauses for guidance on building information modelling for architectural quantity take off

C.1 Framework section 1: Outcomes

The information in this annex shall be required of the application of BIM to the facility/project in order to enable architectural quantity report/observations.

This annex repeats the content in B.1, but uses a formal structure to show how the BIM guidance document can be used systematically for checking and review. This approach is most relevant where quality management procedures and applications are in use. The division of the objective content into applicability, selection, exceptions and requirements and definitions is described in 6.4.

No endorsement of any standard, method or classification is implied by the example presented here.

The outputs and outcomes in Tables C.1 to C.10 shall be obtained for the project.

Table C.1 — 1.3.1.2.A Common quantity take off report

Purpose of clause	Description	Framework reference
Objective	Quantity take off information	
Applicability	Components in specific architectural systems	[2.3.1.C]
Selection	All	
Exceptions	None	
Requirements	a) Level of information shall be specified for common geometric measurements.	[2.3.2.A]
	b) Identification of elements shall be to common naming of elements.	[3.2.1.A]
	c) Grouping of elements shall be by type and construction	[3.2.2.A]

Table C.2 — 1.3.1.2.B National quantity take off

Purpose of clause	Description	Framework reference
Objective	Information on nationally endorsed quantity take off	
Applicability	Quantity report/observations	[1.3.1.2.A]
Selection	All	
Exceptions	None	
Requirements	Grouping of elements shall be by their national classification of work sections.	[2.3.1.B]

C.2 Framework section 2: Controls

Table C.3 — 2.3.2.A Common geometric measurements

Purpose of clause	Description	Framework reference
Objective	Common geometric measurements	
Applicability	All objects with a physical representation	
Selection	Object geometry after deductions for any openings, rebates, chases and addition for features.	
Exceptions	a) Spaces and zones b) Notional openings	
Requirements	a) Net volume b) Net surface area	

Table C.4 — 2.3.1.C Specific architectural systems

Purpose of clause	Description	Framework reference
Objective	Specific architectural systems	
Applicability	Defined systems	
Selection	a) Substructure b) Structural columns beams c) Structural and nonstructural floors, slabs and roofs d) Stairs, ramps and shafts e) Envelope with doors and windows f) Internal divisions and doors g) Fitted furniture and sanitary fittings	
Exceptions	None	
Definition	Common grouping as “architectural systems”	[3.2.3.A]

Table C.5 — 2.3.1.B National classification of work sections

Purpose of clause	Description	Framework reference
Objective	National classification of work sections	
Applicability	All objects representing work	
Selection	a) New objects b) Renovated and remodelled objects c) Deleted and demolished objects	
Exceptions	Objects providing context rather than work.	
Requirements	Common grouping by classification should be according to CSI Masterformat 2004	[3.2.3.A]

C.3 Framework section 3: Inputs

Table C.6 — 3.2.1.A Common Naming of elements

Purpose of clause	Description	Framework reference
Objective	Common naming of elements	
Applicability	All objects representing instances of work or assets	
Selection	a) New objects b) Renovated and remodelled objects c) Deleted and demolished objects	
Exceptions	Objects providing context	
Requirements	a) Names shall be readable b) Names shall be unique within the project/facility	

Table C.7 — 3.2.1.C Specific naming policy

Purpose of clause	Description	Framework reference
Objective	Specific naming of elements	
Applicability	All objects representing instances of work or assets	
Selection	a) New objects b) Renovated and remodelled objects c) Deleted and demolished objects	
Exceptions	Objects providing context	
Requirements	a) Names shall include their object type b) Names shall include a serial sequential three-digit number (for example 001)	

Table C.8 — 3.2.2.A Common Grouping by type and construction

Purpose of clause	Description	Framework reference
Objective	Common grouping by type and construction	
Applicability	All objects representing work or assets	
Selection	a) New objects b) Renovated and remodelled objects c) Deleted and demolished objects	
Exceptions	None	
Requirements	Grouping shall be associated by a single named object	

Table C.9 — 3.2.2.B National grouping by type and construction

Purpose of clause	Description	Framework reference
Objective	National grouping by type and construction	
Applicability	Fabric elements	
Selection	a) Walls b) Slabs c) Roofs	
Exceptions	Specialist work	
Requirements	Grouping by the "Guidance on major construction element naming policy, 2010", for example "Type 5A external wall construction"	

Table C.10 — 3.2.3.A Common grouping by classification

Purpose of clause	Description	Framework reference
Objective	Common grouping by classification	
Applicability	All objects	
Selection	All	
Exceptions	None	
Requirements	a) All elements shall be classified using one or more classification systems. b) Only one value per system shall be used. c) The code of the classification item shall be available. d) The description of the classification item shall be available.	

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