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Organization and digitization of information about buildings and civil engineering works, including building information modelling (BIM) — Information management using building information modelling —

Part 4:
Information exchange

ICS: 35.240.67; 93.010; 91.010.01

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Foreword

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

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

This document was prepared by Technical Committee ISO/TC 59, *Organization of information about construction works*, Subcommittee SC 13, *Information management using building information modelling*.

A list of all parts in the ISO 19650 series can be found on the ISO website.

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

Introduction

ISO 19650 parts 1-3 require the sharing of project and asset information as part of collaborative and convergent processes. These provide the governance and strategy around the execution of both the delivery phase and operational phase of information management. ISO 19650-4 complements parts 1-3 & 5 by providing the explicit process and criteria for an individual information exchange. The intention is to secure the benefits arising from collaborative and interoperable Building Information Modelling (BIM) and choosing 'open' schemas and data formats and conventions whilst defining when alternatives may be appropriate..

Information exchanges occur within the information production and consumption process at every level of project teams and asset/facility management and operation teams (see ISO 19650-2 Figure 2 and ISO 19650-3 Figure 3). It is critical that appropriate criteria are applied to ensure the reliability of the information and the repeatability of the processes. The requirements around information exchange (identified in this Standard) are distinct from any specific "exchange information requirements (EIR)" as used in 19650-1, -2 and -3.

The information exchange process is based on the choice of how information containers (see ISO 19650-1 3.3.12) are defined to ensure that information can be managed.

In this context, an information container

— is given a persistent identifier and other metadata;

— can be retrieved, using a CDE and appropriate status metadata; and

— is made persistent, using revisioning with systematic archiving.

Applicability

This document is applicable to assets of all sizes and all levels of complexity. This includes portfolios of buildings, campuses, infrastructure networks, individual buildings and pieces of infrastructure. The requirements in this document should be applied in a way that is proportionate and appropriate to the scale and complexity of the asset. This document makes use of the phrase "shall consider". This phrase is used to introduce a list of items that the person in question must think about carefully in connection with the primary requirement described in the sub-clause. The amount of thought involved, the time taken to complete it, and the need for supporting evidence will depend on the complexity of the asset, the experience of the person(s) involved, and the requirements of any national policy on introducing building information modelling. On a relatively small or straightforward asset, it can be possible to complete, or dismiss as not relevant, some of these "shall consider" items very quickly. One way to help identify which of the "shall consider" statements are relevant can be to review each statement and create templates for assets of different sizes and complexity.

Relationship with other standards

The concepts and principles relating to the application of the requirements within this document are provided in ISO 19650-1, and in the information exchanges defined in ISO 19650-2 and ISO19650-3. EN 17412-1 (see bibliography[1]) describes a methodology for qualifying an exchange with criteria relating to completeness.

NOTE   Asset delivery and operation have a role in achieving the UN Sustainable Development Goals (bibliography[3]).

Organization and digitization of information about buildings and civil engineering works, including building information modelling (BIM) — Information management using building information modelling —

Part 4:
Information exchange

1 Scope

ISO 19650-4 provides the detailed process and criteria for the decision points when executing an information exchange as defined by ISO 19650 so as to ensure the quality of the resulting project or asset information model. It promotes a proportional and sustainable approach to information exchange where the immediate delivery of information does not limit its future use. It details the implementation of the concepts in ISO19650-1 and is applicable to any information exchange within the delivery stages covered by ISO 19650-2 and operational events covered by ISO 19650-3. The use of appropriate quality assurance and quality control measures supports the fulfilment of a specific Exchange Information Requirement related to an individual information exchange by enumerating criteria relating to completeness, compliance to formal exchange schemas, the continuity of concepts between exchanges and the elimination of spatial and specification conflicts.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/TS 12911, *Framework for building information modelling (BIM) guidance*

ISO/TS 8000-1:2011, *Data quality — Part 1: Overview*

ISO 19650-1, *Organization and digitization of information about buildings and civil engineering works, including building information modelling (BIM) — Information management using building information modelling — Part 1: Concepts and principles*

ISO 19650-2, *Organization and digitization of information about buildings and civil engineering works, including building information modelling (BIM) — Information management using building information modelling — Part 2: Delivery phase of the assets*

ISO 19650-3, *Organization and digitization of information about buildings and civil engineering works, including building information modelling (BIM) — Information management using building information modelling — Part 3: Operational phase of the assets*

ISO 19650-5, *Organization and digitization of information about buildings and civil engineering works, including building information modelling (BIM) — Information management using building information modelling — Part 5: Security-minded approach to information management*

ISO 29481-1:2016, *Building information models — 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, ISO 19650-1 and the following apply

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

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

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

3.1 Terms relating to phases

3.1.1
stage
distinct period in a project used as a management tool

Note 1 to entry: A stage generally terminates at a key decision point (ISO19650-1 3.2.14) .

Note 2 to entry: Handover may be viewed as a delivery stage and as an operational trigger event.

Note 3 to entry: Trigger event is defined in ISO 19650-1 3.2.13.

[SOURCE: ISO 6707-2:2017, 3.3.4, modified. Note 1 to entry removed. The admitted term "phase" has been removed.]

3.2 Terms relating to activities

3.2.1
information provider

Note 1 to entry: Information providers include both the authors of requirements and the providers delivering information according to the requirements.

EXAMPLE 1   A structural engineer will prepare a detailed proposal during a detailed design stage.

EXAMPLE 2   A maintenance team will prepare an inspection report on an asset during an operational event.

3.2.2
information receiver
actor who receives information in an information container

Note 1 to entry: One information receiver may be the appointing party or a lead appointed party with responsibility for the authorization and acceptance of information into the PUBLISHED state. See ISO 19650-1 Figure 6.

Note 2 to entry: For appointing party, lead appointed party and appointed party see ISO 19650-1 3.2.3 and 3.2.4.

3.2.3
information reviewer
actor who reviews information and its information container

Note 1 to entry: The task team leader acts as reviewer before approval out of Work-in-Progress (WIP) state..

Note 2 to entry: The delivery or operational team including the lead appointed party, act as reviewers before the authorization into the PUBLISHED state and its possible acceptance by the appointing party.

Note 3 to entry: An information reviewer may be an artificial intelligence agent or an automated rules-based process.

EXAMPLE   An information provider such as a structural engineer or maintenance team, acts as a reviewer before approval from the Work-in-Progress (WIP) state. Reviews should not only be conducted by the author(s).

4 Process overview

Each information exchange, whether executed during or at the end of a stage or event, shall be executed as specified in ISO 19650-2 5.6 and 5.7 or ISO 19650-3 5.6 and the associated governance arrangements, as summarized in figure 1. Each process is detailed in section 5 and each decision in section 6.
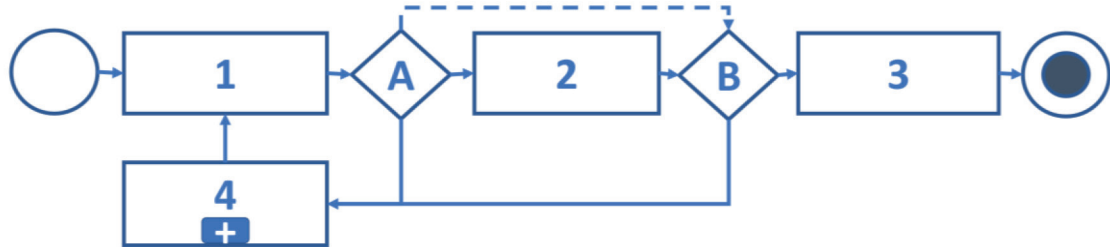
Key

1   Generate Work-in-Progress (see 5.1)
2   Use Shared state (see 5.2
3   Use Published state (see 5.3)
4   Develop Corrective actions (see 5.4)
     Decision A: Approve for sharing (see 6.1)
     Decision B: Authorize and accept for publication (see 6.2)

Figure 1 — Information exchange process

NOTE   Section 6.4 provides the criteria and examples of information exchanges that can omit the SHARED state given other controls, shown dotted.

5 Process steps

5.1 Mobilization and information production

During delivery stages and operational events Information providers shall produce information and develop information containers as Work In Progress. (see figure 1 process 1)..

NOTE   Implementation (5.1.2) may be dependent on steps taken during mobilization (5.1.1).

5.1.1 Mobilization and testing prior to information exchange

The methods and procedures of undertaking an information exchange shall be tested to ensure flow of information, prior to finalizing requirements and exchanging deliverables.

The information provider shall review and confirm the choices of authoring software to use during mobilization (ISO 19650-2 5.4 and ISO 19650-3 5.4).

To facilitate the information development process, the information provider shall select authoring software that supports:

— Import of the schemas and data formats of relevant reference information

— Export of the requested schemas and data formats

— Interaction with any agreed issue and risk registering and agreed management tools.

3

The information receivers shall consider the need for information exchange using:.

— open schema and data format standards that allow cross-party collaboration

— proprietary or native data formats where this does not disadvantage any information receivers' immediate or future needs,

NOTE   Open schemas and data formats are summarised in annex A.

The information receivers shall check and confirm the choices of review and integration software (ISO 19650-2 5.4 and ISO 19650-3 5.4) capable of the appropriate handling of information exchanges including:

— Importing into a persistent information container;

— Federating using applications to create a temporary information resource; and

— Linking as information references or semantic web linking.

The information receivers and reviewers shall review and confirm the versions of open data formats and proprietary data formats to be used.

5.1.2   Implementation

All information development and information exchanges shall be executed under the appropriate security management plan (see ISO 19650-5).

The information provider shall generate information as 'work in progress' (using other SHARED and/or PUBLISHED resources as background information).

The information provider shall plan the exchange of information, to support collaborative working and the CDE process as described in ISO 19650-1 clause 12, and exchange it in accordance with the agreed governance (see ISO 19650-2 section 5.5 or ISO 19650-3 section 5.5) with appropriate status when:

— the information is in a coherent state, (see ISO 19650-2 5.7);

— early in a delivery stage or operational event; and

— often, when changes have been made.

NOTE   See 6.1 for the subsequent decision A for approval into SHARED state.

5.2   Shared state

Information reviewers shall review the information container, using the SHARED information as reference material and context where necessary. (See ISO 19650-1 section 12). See figure 1 process 2.

NOTE   See 6.1 for the preceding decision A for approval into SHARED state.

NOTE   Reference information may be provided by the appointing party or other teams.

NOTE   See 6.2 for the subsequent decision B for authorization and acceptance into PUBLISHED state.

5.3   Published state

The information receiver shall use the information exchanged in the PUBLISHED state for the key decisions, completion of a delivery stage or operational event and subsequent, stages and events (See ISO 19650-1 section 12). See figure 1 process 3.

NOTE   See 6.2 for the preceding decision B for authorization and acceptance into PUBLISHED state..

5.4   Change actions

Change action can be required from issues and risks detected at decision A and at decision B (see figure 1, process 4), as illustrated in figure 2.

Key

4.1   Identify issues and risks (see 5.4.1)

4.2   Allocate issues and risks (see 5.4.2)

4.3   Implement corrections (see 5.4.3)

Figure 2 — Change action process

5.4.1   Identify issues and risks.

An information reviewer shall review the information to identify any issues and risks relevant to the purpose for the information exchange (see figure 2 process 4.1).

EXAMPLE   The structural engineer can review their coordination models against any shared coordination models.

EXAMPLE   In response to the outcome of a thermal analysis, the mechanical engineer resizes the air handling unit, and updates the mechanical coordination model. The electrical engineer must review the coordination model and respond to new electrical supply demands of the mechanical systems.

EXAMPLE   The maintenance team can review that the received report uses agreed equipment identifiers.

NOTE   A collaborative issue register may hold the information delivery risks (see ISO 19650-2 5.3.6 and ISO 19650-3 5.3.6). Commercial, operational and health-and-safety risks may be handled separately.

5.4.2   Allocate issues and risks

An information reviewer shall document all identified issues and risks for revision and corrective actions to the lead appointed party or as set out in the appointment. A determination can then be made as to whether the issue or risk can be allocated directly or requires a collaborative review (see figure 2 process 4.2).

NOTE   Documentation may be through BCF (see bibliography[15]) or other messages or may be entered directly into a register.

5.4.3   Implement corrections

The information provider shall implement any necessary revisions and change actions in their WIP, (see figure 2 process 4.3), by returning to 5.1.2 (figure 1, process 1.2).

NOTE   Only the originating team, as the information provider, can modify and revise an information container in their WIP

6   Decisions on change of state

6.1   Decision A: Approve for SHARING

An information provider shall review their information using the criteria in section 7 prior to either withholding or granting approval for the information to transition to the SHARED state (see ISO 19650-1 section 12.3, ISO 19650-2 section 5.6.3 and ISO 19650-3 5.6.3). See figure 1 decision A and 5.4 for corrective actions.

An information provider shall consider the effectiveness of the processes in effect:

— Quality assurance processes by the information provider to ensure compliance; and

— Quality control processes by the information provider and receivers to check for compliance.

6.2   Decision B: Authorize and accept for PUBLICATION

The Information receiver shall review an information container using the criteria in section 7. The information receiver shall either reject or authorize and accept for the PUBLISHED state (see ISO 19650-1 section 12.5, ISO 19650-2 section 5.7.2 and ISO 19650-3 5.6.6). See figure 1 decision B.

NOTE   This decision process can be carried out in two steps, the first requiring authorization by the Lead Appointed party and the second requiring acceptance by the Appointing Party, as described in ISO 19650-2 clause 5.7.4 and ISO 19650-3 clause 5.7.2.

The information reviewers shall consider the effectiveness in ensuring compliance of the quality management processes including:

— Quality control and assurance processes applied by the information provider before sharing; and

— Quality control processes applied by information reviewers after sharing.

6.3   Decision criteria

An information reviewer shall support or endorse the information exchange prior to decision A on sharing or prior to decision B on publication if the acceptance criteria in clause 7 are met, or otherwise raise the pertinent issues for resolution. Figure 3 illustrates sources for criteria.

All the criteria shall be applied to all information containers, except as allowed in 6.4.

NOTE 1   Criteria may be derived from ISO 12911, ISO 29481-1 and EN 17412-1 1 (see bibliography[1]), and from the Information Standard, Shared Resources, Information Production Methods and Procedures and any EIR as defined in ISO19650-2 and ISO19650-3.

NOTE 2   These criteria can be in the IS, IPMP and the applicable EIR and are outlined in ISO 19650-1 section 11.3. See also ISO 19650-2 5.2.1 and ISO 19650-3 5.2.2.d and 5.4.3.

NOTE 3   Structured information and consistent processes may support systematic and automated compliance checking.
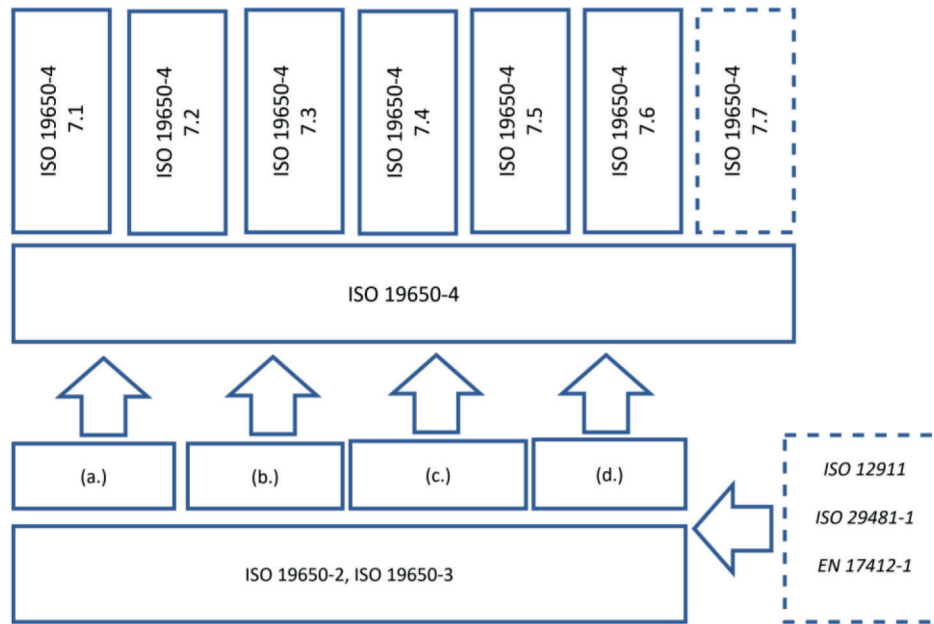
Key

a. Project/Asset Information Standard

b. Project/Asset Shared Resources

c. Project/Asset Information Production Methods and Procedures

d. EIR

Figure 3 — Sources of criteria

6.4 Exceptions

The review process may exclude information containers that are not subject to revision or change as long as the quality, naming and metadata associated are checked by the information receivers.

The information reviewers shall consider exempting the following cases:

— Electronic representations of physical evidence related to administration, certificates and acceptance documents.

— Direct process monitoring signals once appropriate automatic filters and triggers have been established following their initial activation.

— Photographs, scans and video material.

7 Criteria for reviewing an information exchange

7.1 Common Data Environment (CDE)

The information reviewer shall check that the naming and metadata requirements of the CDE are being correctly applied to the information container.

The information reviewer shall check that security and handling requirements have not been breached, especially relating to the visibility of the information container to others.

NOTE 1   Refer to ISO 19650 part 1 section 12, part 2 section 5.1.7 or part 3 section 5.1.9 and ISO 19650-5.

NOTE 2   If the CDE is composed of multiple CDE solutions, then it may also be necessary to check that the naming and metadata is retained and that the legally significant archive is maintained.

7.2   Conformance

The information reviewer shall check the information container against the chosen exchange schema and data format.

NOTE 1   These checks are part of the checks against the project information standard in ISO 19650-2 clause 5.6.3, against the asset information standard in ISO 19650-3 clause 5.6.3 & 5.6.6, and against the acceptance criteria mentioned in ISO 19650-2 clauses 5.7.2 and 5.7.4 and ISO 19650-3 clause 5.7.2.

EXAMPLE   Checking that the schema adheres to ISO 16739-1 and the data format adheres to ISO 10303-21 as agreed in the Project/Asset Information Standard.

7.3   Continuity

The information reviewer shall check for the stability of the content compared with:

— other information containers;

— previous versions for the current information container;

— previous status changes;

— previous delivery stages and operational events; and

— previous delivery or operational phase.

with respect to:

— geospatial co-location, including geo-location, site location and asset location;

— calendar coordination;

— spatial, physical and process entity naming including process, site, facility, storey/region, types and systems and zones, packages and method statements;

— space/location, component and task entity naming; and

— attribute, material and shape/profile naming

NOTE 1   This is necessary to support comparisons and progress tracking, ensuring that only actual changes are detected.

NOTE 2   These checks explain in more detail the information container and information model reviews mentioned in ISO 19650-2 clauses 5.6.4, 5.6.5 and 5.7.2, and in ISO 19650-3 clauses 5.6.4, 5.6.5 and 5.6.6.

7.4   Communication

The information reviewer shall check that the exchanged information can be or has been stored without degradation or loss due to translation or conversion.

NOTE 1   Degradation can only be detected after the information container has been exchanged, so tests should also be conducted during mobilization, and any lessons learned applied.

The information reviewer shall consider effects due to changes of:

— date format or calendar assumptions;

— units of measure; and

— character sets or encoding.

The information reviewer shall consider effecting comparison using:

— visualizations;

— reports; and/or

— file size and check-sums.

NOTE 2   These checks explain in more detail the information model reviews mentioned in ISO 19650-2 clause 5.7.4 and ISO 19650-3 clause 5.7.2.

7.5   Consistency

The information reviewer shall check for the internal consistency with any referenced information containers in terms of:

— Spatial, physical and process coherence including the absence of duplication and conflicts such as overlaps or gaps;

— Attribute and property coherence such as contradictions;

— Gaps or overlaps with adjacent information containers within the federation strategy;

— Mistaken allocation with other information containers within the federation strategy; and

— Appropriate accuracy including quantitative accuracy of locational and property values and thematic accuracy of classification and text properties.

An information reviewer shall consider the intended status code prior to SHARED state or the assigned status code prior to PUBLISHED state as defined in ISO 19650-1 section 3.3.12 and 12.1.

NOTE 1   These checks explain in more detail the information container and information model reviews mentioned in ISO 19650-2 clauses 5.6.4, 5.6.5 and 5.7.2, and in ISO 19650-3 clauses 5.6.4, 5.6.5 and 5.6.6.

7.6   Completeness

An information reviewer shall check for the presence and adequacy of the information against the Level of Information Need specified by the EIR and any additional expectations.

NOTE 1   This can include entities, relationships, properties and shape, and their representations and descriptions (see ISO/TS 12911 and EN 17412-1 1 (see bibliography[1])).

An information reviewer shall consider the following three requirements.

— to satisfy the purposes associated to the immediate delivery stage or operational event;

— to support oversight and coordination of the delivery or operational phase, including support for coordination of spatial, physical and process aspects; and

— to enable long-term management and societal requirements, using standard naming and classification and open standards.

An information reviewer shall consider:

— the intended status code prior to SHARED state or the assigned status code prior to PUBLISHED state as defined in ISO 19650-1 section 3.3.12 and 12.1

— using a formalized procedure when checking against the information requirements or checklists derived from them possibly including structured rules using repeatable automated processes.

— means of sharing checking procedures with information providers through the information production methods and procedures.

NOTE 2   IDM/MVD/IDS definitions may have a role in checking for the completeness in terms of entities, relationships, properties and geometry (see ISO 29481).

NOTE 1   These checks explain in more detail the checks against level of information need mentioned in ISO 19650-2 clauses 5.6.4, 5.7.2 and 5.7.2, and in ISO 19650-3 clauses 5.6.4, 5.6.6 and 5.7.2.

7.7   Other criteria

The information reviewer can also check for satisfaction of the asset delivery and/or operational requirements using judgement and analysis tools as appropriate. Delivery and operational phase requirements can have been articulated within appointment documentation

The reviewer can consider:

— functional criteria;

— capacity and performance criteria;

— technical standards;

— commercial and legal requirements; and

— health and safety considerations.

NOTE   This review can be particularly significant at the end of each delivery stage or operational event. See CEN/TR 17439-1 (6.4) 1 (see bibliography[2]).

Annex A
(informative)

Open schema and data format standards

A.1 Open schema

Open schema supporting cross-part communication include:

Table A.1 — Open schema

Name	ISO Standard (bibliography[4-6])	Data Format	File suffixes
IFC	ISO 16739-1	spf xml rdf/owl	.ifc .ifcxml
GML	ISO 19136	xml	.gml
Posc/Cesar	ISO 15926	.spf	

Other regionally or sector defined open schemas and data formats are in use (see bibliography[16-19]):

a. CAFMconnect for built asset orientated handover

b. COBie for built asset orientated equipment and impact handover

c. CFIHOS for plant-orientated handover

d. Oscre for various property related transactions

Open schema and data formats may be checkable using formal requirements definitions such as ISO 29481-3 mvdXML/IDS (forthcoming)

A.2 Open data formats

Open data formats allowing cross-party communication include:

Table A.1 — Open data formats

Use	ISO Standard (see bibliography[7-13]):	Data Format	File suffixes
Document, Spreadsheet	ISO 29500	xml	.docx .xlsx .csv
Document, Sheet	ISO 32000		.pdf
office document	ISO 26300	xml	.odt .ods .odp
portable document	ISO 19005		pdf
portable document	ISO STS	xml	pdf
RDMS	ISO 9075-1	text	.sql .gql
Image	ISO 10918		.jpg
Image	ISO 15948		.png

Table A.1 *(continued)*

Use	ISO Standard (see bibliography[7-13]):	Data Format	File suffixes
Multi container package	ISO 21597-1 and -2	zip, rdf-xml	.icdd

BCF (see bibliography[15]) is an international industry consensus defined open schema and data format for the identification, communication and exchange of issues.

PD ISO TR 22299 (see bibliography[14])c overs the significance of information container standards in more detail.

Bibliography

Standards publications

For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

[1]   EN 17412-1 Level of Information Need - Concepts and principles

[2]   EN/TR 17439-1 Guidance on how to implement EN ISO 19650-1 and -2 in Europe

[3]   ISO TC251 Asset management - Achieving the UN Sustainable Development Goals https://committee.iso.org/files/live/sites/tc251/files/guidance/ISOTC251SDGMarch2018.pdf

[4]   ISO 16739-1 Industry Foundation Classes (IFC) for data sharing in the construction and facility management industries - Part 1:Data schema

[5]   ISO 19136 Geographic information — Geography Markup Language (GML)

[6]   ISO 15926 Integration of life-cycle data for process plants, including oil and gas production facilities.

[7]   ISO 26300 Information technology — Open Document Format for Office Applications (OpenDocument)

[8]   ISO 29500 Information technology — Document description and processing languages — Office Open XML File Formats

[9]   ISO 32000 Document management — Portable document format

[10]   ISO 9075-1 Information technology — Database languages — SQL

[11]   ISO 10918 Information technology — Digital compression and coding of continuous-tone still images

[12]   ISO 15948 Information technology — Computer graphics and image processing — Portable Network Graphics (PNG)

[13]   ISO 21597-1 and -2 Information container for linked document delivery. Exchange specification Container

[14]   PD ISO TR 22299 Document management — Digital file format recommendations for long-term storage

Other resources

[15]   BCF https://technical.buildingsmart.org/standards/bcf/

[16]   CAFMconnect https://www.cafm-connect.org/

[17]   COBie https://www.nationalbimstandard.org/files/NBIMS-US_V3_4.2_COBie.pdf

[18]   CFIHOS https://www.jip36-cfihos.org/

[19]   Oscre: https://www.oscre.org/