



Manage your project information by implementing ISO 19650

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CHAPTER 1

Who is this guide for?

This guide is for users who are new to the topic of ISO 19650 and would like guidance on how to implement it in their projects. In this paper, we will review the ISO 19650 family of standards, how it applies to building information modelling (BIM) and the common data environment (CDE), and how Autodesk tools can support your organisation with standards adoption.



CHAPTER 2

Overview ISO 19650

ISO 19650 is a new international BIM standards family that defines the collaborative processes for managing information over the whole lifecycle of a built asset using BIM.

Inefficiencies stemming from poor management of information and a lack of collaboration during architecture, engineering and construction (AEC) industry projects are well-documented. BIM standards such as the ISO 19650 series enable teams to minimise wasteful activities and increase predictability around cost and time. The standards can help all AEC project teams to build a cohesive way to share, publish and review design and construction documentation to ensure that all parties have access to the right information at the right time.

ISO 19650 is being issued in six parts (see Figure 1), with ISO 19650-1 (Concepts and principles), ISO 19650-2 (Delivery phase of assets), ISO 19650-3 (Operational phase of assets), and ISO 19650-5 (Security-minded approach to information management) published, and ISO 19650-4 (Information exchange) and ISO 19650-6 (Health & safety use of BIM) not yet published.

The ISO 19650 standard provides guidance for storing and managing project data. This includes the use of “information containers” and a common data environment (CDE) to support ISO 19650 processes.



The six parts of ISO 19650

Organisation of information about construction –
Information management using building information modelling

Part 1

Concepts and principles

Part 2

Delivery phase of assets

Part 3

Operational phase of assets

Part 4

Information exchange

Part 5

Security-minded approach to information management

Part 6

Health and safety

Figure 1 – The six parts of ISO 19650



Information container

An information container is a named persistent set of information retrievable from within a file, system or application storage hierarchy. Structured information containers include geometrical models, schedules and databases. Unstructured information containers include documentation, video clips and sound recordings.

Common data environment (CDE)

A CDE is a workflow supported by a technology solution or solutions. It should be implemented to create a single source of information used to collect, manage and disseminate documentation, the graphical model and non-graphical data for the whole project team. Companies can implement the CDE solution or solutions using a range of technologies and should consider security and information quality into their CDE proposal.

A CDE connects teams, companies and project owners, offering a more sophisticated, seamless and efficient way to share information. Typically, a project team passes information between groups and team members as needed, using a multitude of different systems and software platforms. This can make it difficult to ensure that each team member has the most accurate

and up-to-date information at the right time and can lead to costly mistakes created by errors in manual information exchange processes. In contrast, using a CDE, the information flows through a central repository, where it can be more easily controlled and kept up to date. To ensure security and reliability, information flow can be gated by mechanisms that ensure that construction documents and other information such as mark-ups and issues are only available when appropriate.

Using a CDE can mitigate common challenges (see Figure 2, page 5) during the design, construction and handoff processes, including problems with integrating software solutions, data loss, costly rework due to poor project data and time spent looking for information.



Up to 30% of all data created in design and construction phases is lost at project closeoutⁱ



26% of all construction professionals report that none of their software solutions integrateⁱⁱ



52% of all rework globally is caused by poor project data and miscommunication. In 2018 in the US alone, this cost \$31.3 billionⁱⁱⁱ



Construction professionals report spending 13% of their time—over 5 hours per 40-hour workweek—simply looking for data and information^{iv}

Figure 2 – Challenges associated with traditional methods of project information management

Creating a single source of information facilitates collaboration between team members and helps mitigate risks on a project, including duplication of documentation, and mistakes related to referring to incorrect or out-of-date documentation. It reduces the time spent searching for, sharing and coordinating information; promoting better decision-making.



ISO 19650 and the project and asset management lifecycle

The ISO 19650 family of BIM standards for information management builds on existing standards for organisational management, such as ISO 9001, standards for asset and project management, such as ISO 55000 and ISO 21500. As such, it is part of a hierarchy of standards associated with built assets, used to demonstrate the professionalism of a business and its projects.

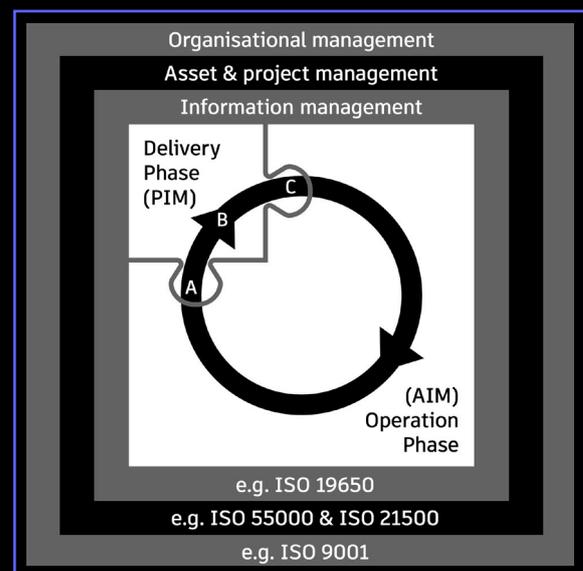
ISO 9001 is the international standard that specifies requirements for a quality

management system (QMS). Organisations use the standard to demonstrate their ability to consistently provide products and services that meet customer and regulatory requirements.

ISO 55000 (Asset management) and ISO 21500 (Project management) allow organisations to bring consistent best practices to their asset and project management, while meeting performance and safety requirements and streamlining costs.

Autodesk tools support the full information management lifecycle (see the cycle in Figure 3), providing organisations with a platform to access data at the beginning right through to the end of a project.

- A** Start of delivery phase – transfer of relevant information from the asset information model (AIM) to the project information model (PIM)
- B** Progressive development of the design intent model into the virtual construction model
- C** End of delivery phase – transfer of relevant information from the PIM back to the AIM



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Figure 3 – Generic project and asset information management lifecycle graphics developed from images created and copyrighted by ISO.

CHAPTER 4

Global adoption of BIM standards

The ISO 19650 family of standards is being adopted in many countries globally as a project collaboration specification, with national agencies, public projects and private owners considering its implementation. Currently, these countries include the UK, Japan, the US, Australia, Finland, Denmark, Singapore, South Korea and Germany, and is in the process of being adopted in many more countries across Europe, the Middle East, South America and Asia. There is also an opportunity for every country to develop its own annex, or unique local standard that incorporates national industry norms to enhance the applicability of the ISO 19650 standards or the ISO 19650 family of standards.

Some governments, for example the UK government, are mandating ISO 19650 standards on many public sector projects. Governments in Chile, Singapore, Vietnam and some public agencies across Europe are also considering following suit. Outside the public sector, the private sector is also following suit with many introducing the processes and procedures aligned to the ISO 19650 standards. Ranging from construction organisations to airport authorities to engineering firms, they are all seeing the benefits of the standards.



ISO 19650-1: Concepts and principles

ISO 19650-1 introduces the concepts and principles for information management using BIM. It provides a framework for managing information, such as exchanging, recording, versioning and organising information for all project stakeholders. This framework is applicable to the whole lifecycle of any built asset, including strategic planning, initial design, engineering, development, documentation and construction, day-to-day operation, intenance, refurbishment, repair and end-of-life.

The concepts and principles apply to the full information management lifecycle (see Figure 4), from defining the requirements, to collaborative information production and the technology infrastructure and process required to deliver this. Two of the critical requirements, “container-based collaborative working” and “CDE solution and workflow” (highlighted in black in Figure 4), are examples of where Autodesk solutions and workflows support the move from uncontrolled information exchange to a controlled and secure method of collaborative working.

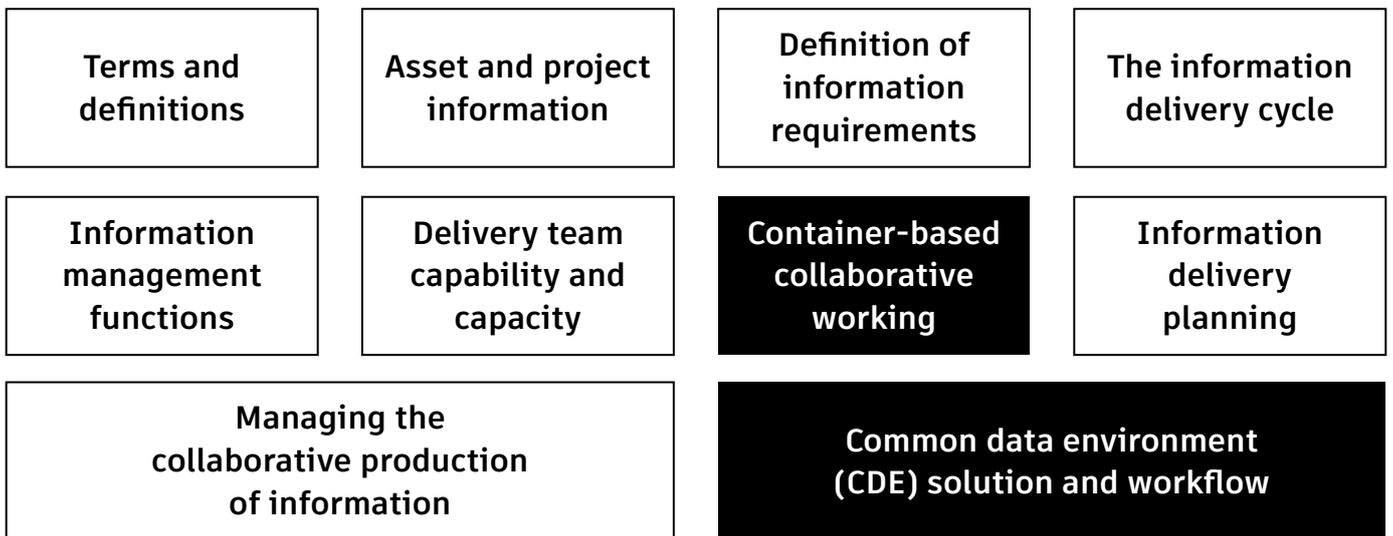
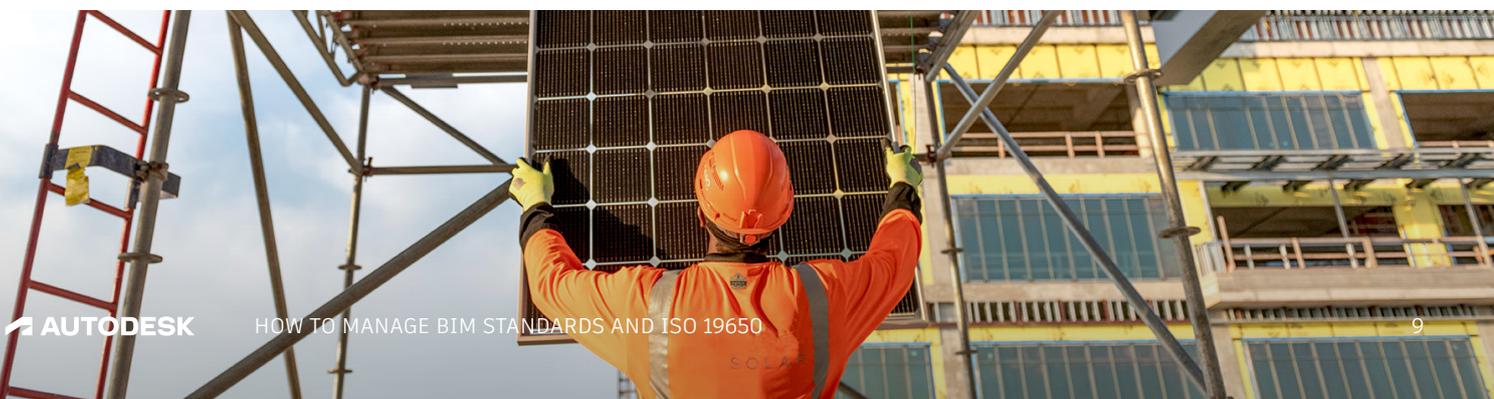


Figure 4 – ISO 19650 Concepts and Principles





The ISO 19650 framework is intended to be adaptable to projects of any scale and complexity, so that it can be flexibly applied in a “proportionate and appropriate” way (see Figure 5).

This gives firms the flexibility to set up their systems and processes with the amount of administrative control that their project demands. To determine the proportionate and appropriate scale for your project, consider its complexity, the number of participants, the allocated time and budget, and the technology “ that has been adopted to deliver it.

Introduction to ISO 19650

0.1 Purpose This document is designed to enable an appointing party to establish their requirements for information during the delivery phase of assets and to provide the right commercial and collaborative environment within which (multiple) appointed parties can produce information in an effective and efficient manner. This document is applicable to built assets and construction projects of all sizes and all levels of complexity. This includes large estates, infrastructure networks, individual buildings and pieces of infrastructure, and the projects or programmes that deliver them. However, the requirements included in this document should be applied in a way that is proportionate and appropriate to the scale and complexity of the asset or project. In particular, procurement and mobilisation of asset or project-appointed parties should be integrated as far as possible with documented processes for technical procurement and mobilisation.

Figure 5 – Excerpt from ISO 19650-2:2018 (Delivery phase of assets), Introduction



ISO 19650 and the CDE

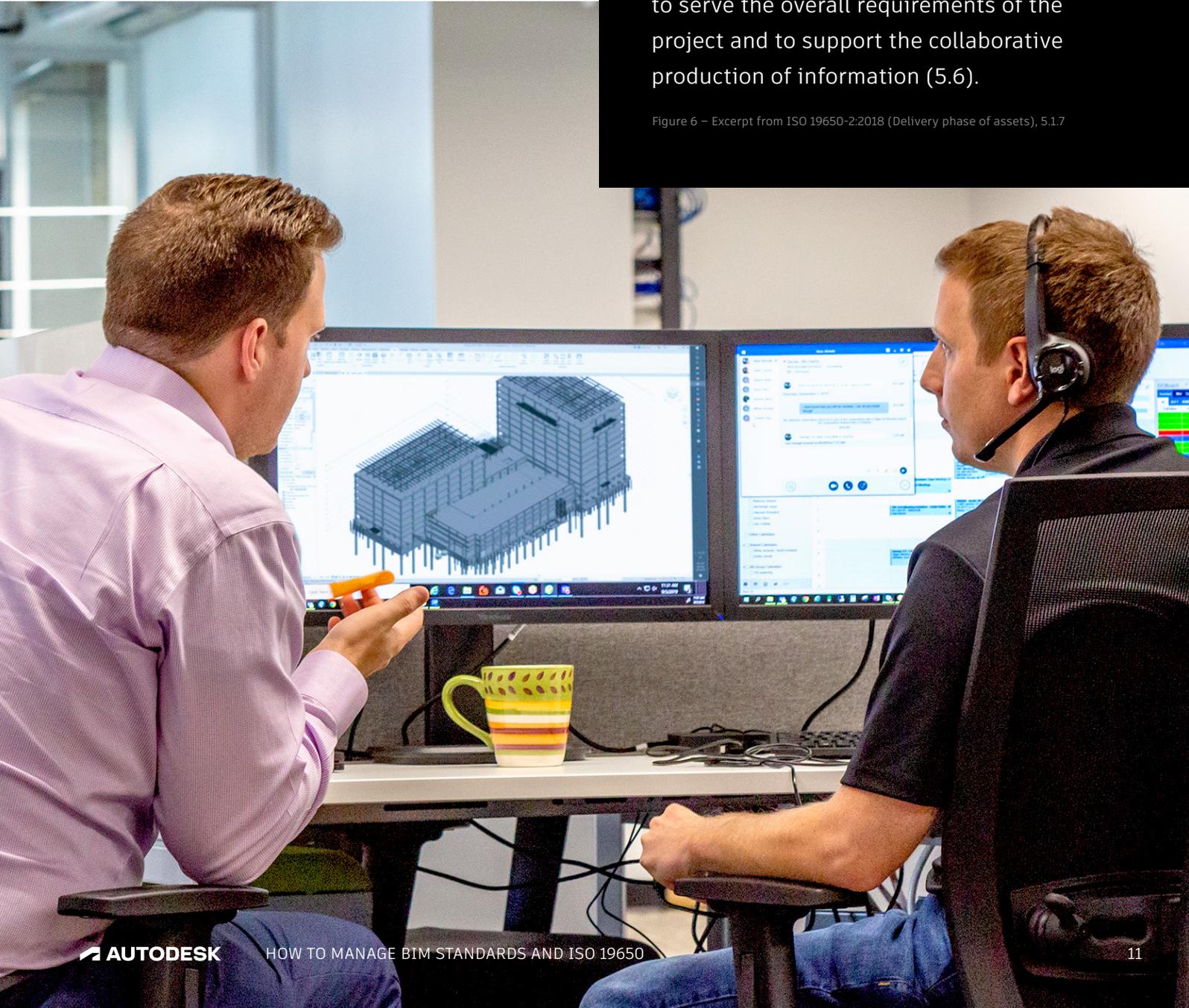
ISO 19650-2 (Delivery phase of assets) has specific requirements related to a CDE solution and workflow. It requires that the CDE is established to allow project teams and stakeholders to create and share information collaboratively (see Figure 6).

“

5.1.7. Establish the project's common data environment

The appointing party shall establish (implement, configure and support) the project's common data environment (CDE) to serve the overall requirements of the project and to support the collaborative production of information (5.6).

Figure 6 – Excerpt from ISO 19650-2:2018 (Delivery phase of assets), 5.1.7



The CDE concept

The CDE is there to support the collaborative production of information by enabling teams and individuals to work together in a centralised repository, sharing information effectively and in a controlled way. This ensures greater project efficiency, and helps to maintain security by providing individuals with access to information on a 'need-to-know' basis.

Below are the key stages in the CDE concept. Figure 7 illustrates how information flows through each of these key stages in the CDE.

Work in progress

The Work in Progress (WIP) state allows multiple task teams to develop information individually, without other parties having access to it, in line with their contribution to the project.

Shared

WIP containers that are at a suitable level of development and completeness need to pass through a check/review/approve gateway, to transition to being shared with the relevant task teams, delivery teams or other stakeholders as required. In the Shared state, other members of the project delivery team can collaborate to refine the information model.

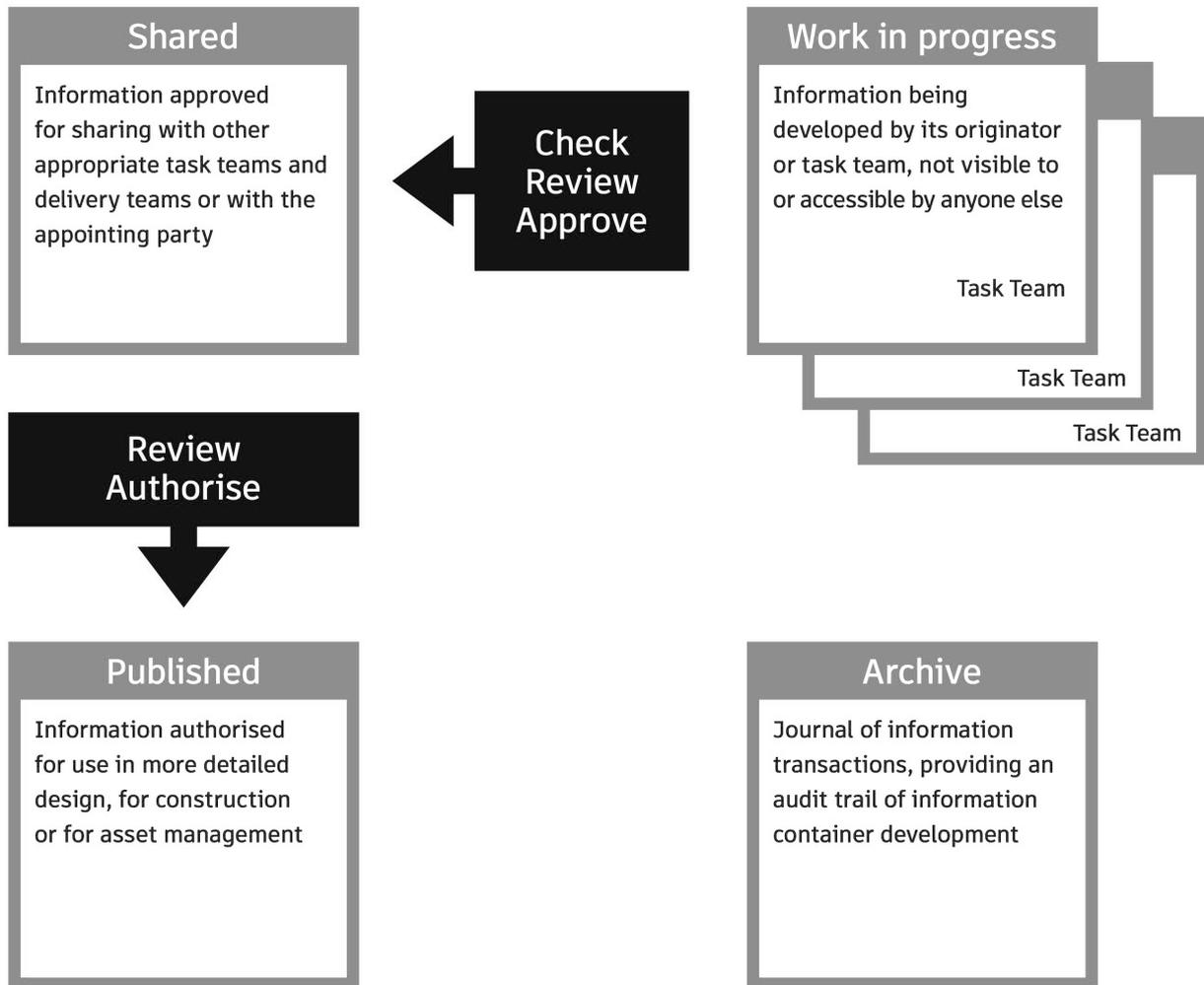
Published

Once information containers are deemed to meet completeness against an information requirement, they must then pass through a review/authorise gateway in order to transition to the Published state for use for contractual purposes such as further detailed design for costing, for construction or for asset management. Note that ISO 19650 also recommends that the appointing party (e.g. the end client) may also have to review and accept that the container meets stage information requirements before adoption in the Published state.

Archive

Additionally, for containers that have been in the Shared or Published states, ISO 19650 requires an Archive state to record past versions of containers, as well as detail on who checked the information, when they checked it, what the outcome was, who approved it and who reviewed it, providing a complete, transparent audit trail of project information development.

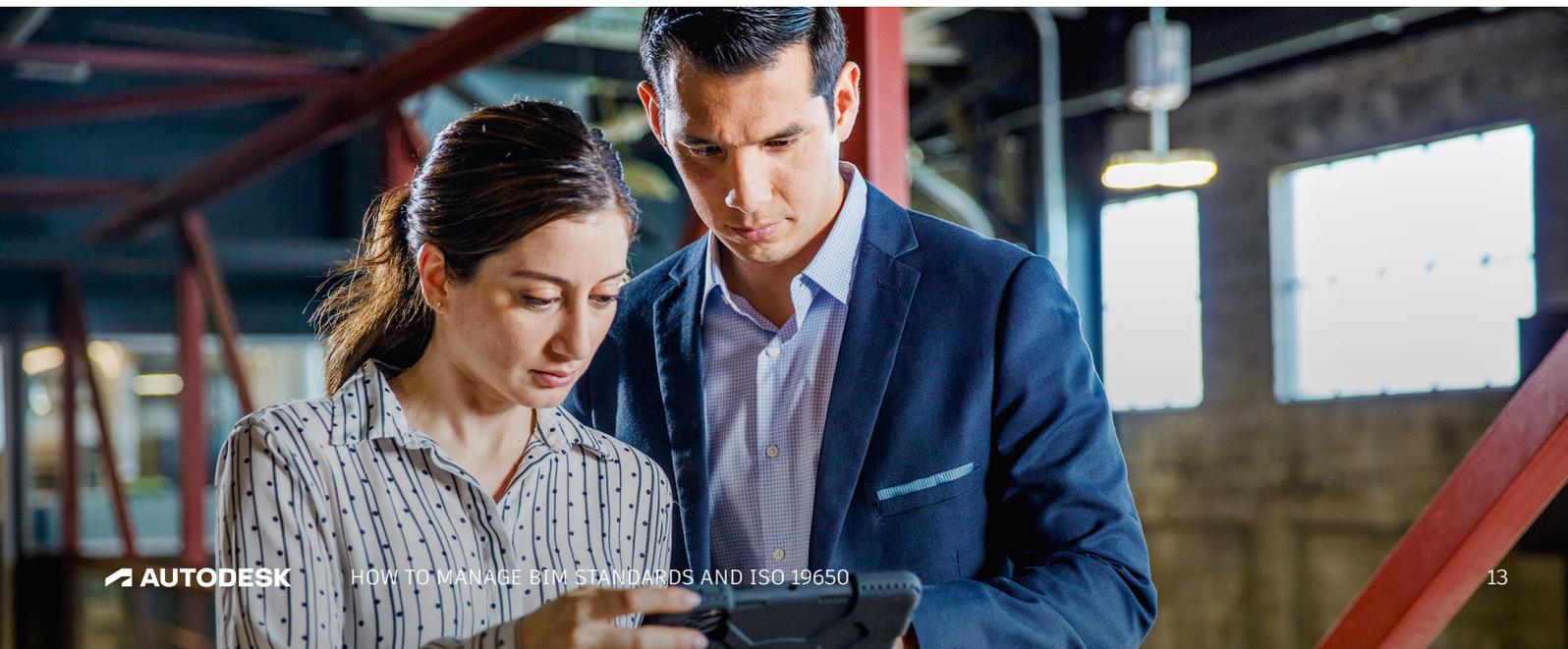
The gateways (shown in black in the figure) ensure that information that is shared or published has been checked for errors that might otherwise cause problems further down the line, as well as ensuring it meets obligations set out in the project information requirements. This is also an opportunity to label the information to ensure that its purpose is clear—for example, information may just be for reference or may be intended for coordination purposes.



A third workflow could be introduced that would follow review-authorise, which is review-accept on behalf of the appointing party. This is applied where the containers are published to meet an information requirement and need to be checked for completeness and correctness.

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Figure 7 – The Common Data Environment (CDE) concept Graphics developed from images created and copyrighted by ISO.

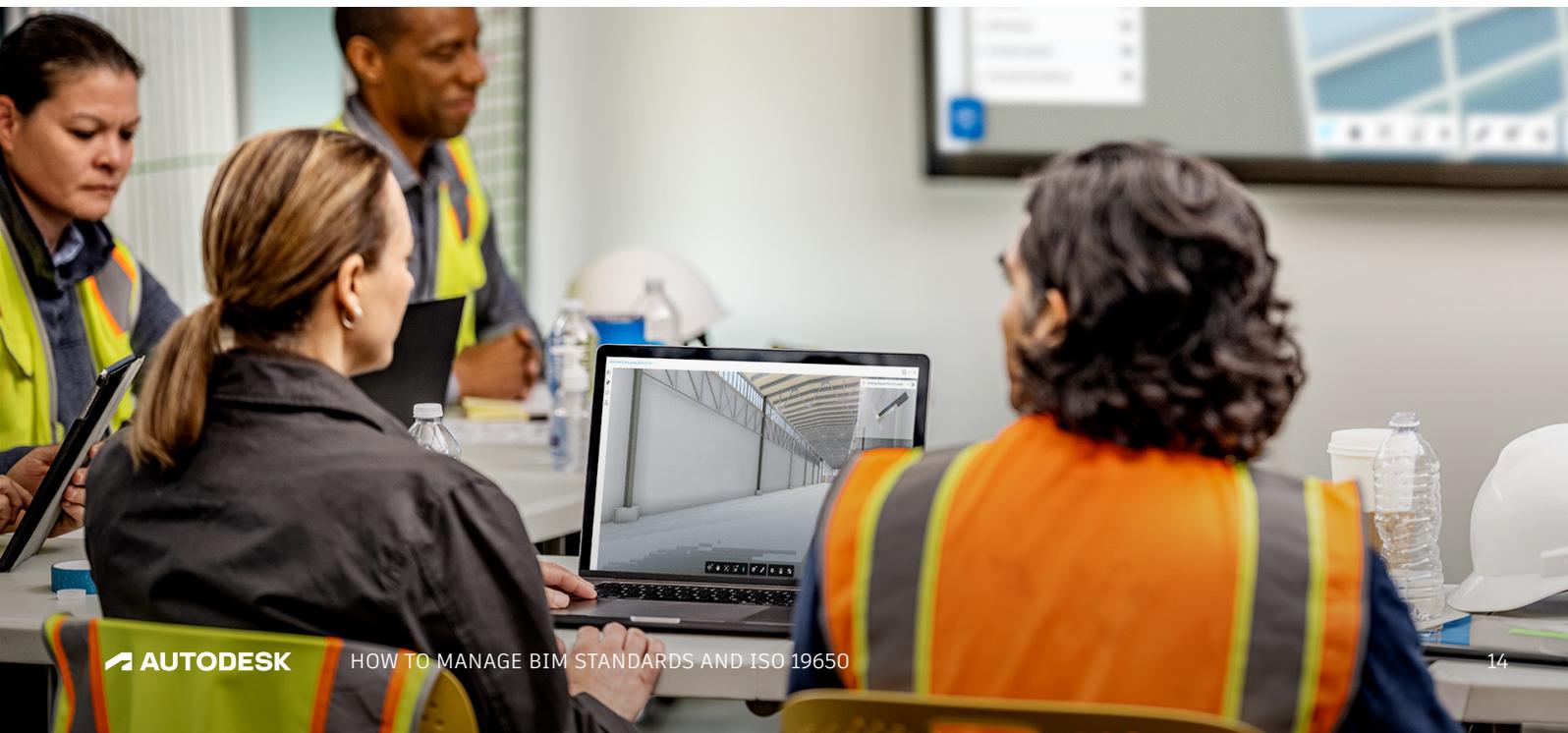


Establishing a standards-aligned CDE

The CDE must enable specific features and functionalities for information containers (this may be a drawing, a model, a file or some other piece of data), metadata, auditing, permissions and authorisation controls to meet ISO 19650 standards. Outlined on the right are some of the key requirements to consider for each step in establishing a CDE.

Establishing a standards-aligned CDE

- Each must have a unique, standard identification based upon an agreed and documented convention, comprised of fields separated by a delimiter.
- Each field must be assigned a value from an agreed, documented codified standard in line with the relevant country national annex.
- Each information container needs to have attributes assigned to indicate the data's status (suitability), revision and classification in accordance with the framework defined in ISO 12006-2:2015 (Framework for classification):
 - The ability to classify the data and to assign specific “suitability status” to ensure that anyone accessing and using that data can be confident in the reliability, accuracy and intended use.
 - Revision control, so that only specific revisions are available for use by the project team, ensuring that everyone is working from the correct and latest information.
 - Controlled information flow and approval processes to ensure that only approved information goes from Work in progress to Shared to Published.



Functionality

Much of the functionality required by ISO 19650 is already supported by existing workflows in Autodesk's BIM 360 Docs and Autodesk Docs, including:

- Apply unique, standard container identification
- Use common metadata for containers featuring multiple files
- Support search functionality for containers using assigned metadata
- Enable containers to transition between states, e.g. from Work in progress to Shared, or from Shared to Published
- Record the user's name and the date at the point of each transition, enabling an accurate audit trail to be created throughout the lifecycle of each information container, and the project as a whole.

Authorisation controls

There are three points within the CDE concept where authorisation is required to transition an information container from one state to another: the check/review/approve transition point and the review/authorise transition (and the review-accept transition, if this is being used) (see Figure 7, page 13). These authorisation controls can be managed within Autodesk BIM 360 Docs and Autodesk Docs, where reviewers and approvers are specified by the initiator, and once the process is complete, the information container can transition from one state to the next.

Access control

The CDE must allow access to be controlled at an information container level. This is also supported by Autodesk BIM 360 Docs and Autodesk Docs, which allow access to be granted at the folder level, with permissions from 'view only' to 'full control' as needed. Permissions can be configured hierarchically, allowing for greater control and are carried through to authoring tools to ensure security of sensitive information. For example, for an organisation working on a high-security project like a government building whose CDE includes information relating to secure access routes, this feature would enable them to restrict these specific information containers to just a few select individuals.



Creating a CDE using Autodesk tools

Autodesk BIM 360 and Autodesk Docs can be used as a CDE for managing information developed and exchanged between parties involved in the construction project lifecycle. The CDE is a key aspect of the ISO 19650 series of standards that define information management principles and requirements in the context of the digital transformation of the built environment.

To use ISO 19650 workflows on your Autodesk BIM 360 Docs or Autodesk Docs project, a Project Admin must define a naming standard. The naming standard includes the naming convention, attributes defined in the ISO 19650 series of standards, rules that define which folders the naming standard is applied to and the rules that define how documents uploaded to the system are handled. The naming standard is not included in project templates.

Here are the steps you would take to set up Autodesk BIM 360 Docs or Autodesk Docs as your CDE:

1 Identify metadata customisation requirements

Apply custom attributes, which as a minimum should comprise the ISO 19650 recommendation of status, revision and classification.

2 Define the naming convention fields

In an Autodesk BIM 360 Docs or Autodesk Docs project, project admins can click through each tab of fields to define the naming standard. Default fields include Project, Originator, Volume/ System, Level/Location, Type, Role and Number; however a user may re-name, re-order or add new naming convention fields per their project's standards.

3 Customise related attributes

In addition, by default, there are three more related attributes used to describe how information is managed in the CDE– Status, Revision and Classification. Project admins can activate or deactivate status codes, adjust the number of digits used in revision codes, and, where it is adopted, choose the classification system for their project or add other predefined attributes for capturing metadata at the file upload time.

4 Add attributes

In addition to adding attributes directly from the Document Management module in the Naming Standards tab, you can now create and manage attributes from the Attributes tab. (See how to do so in our help sites for [Autodesk BIM 360 Docs](#) and [Autodesk Docs](#).)

5 Arrange the order of attributes

You can arrange the order in which attributes appear not only within the list itself, but also within the Project Files folders. When you return to the respective Project Files folders after adjusting the order of attributes, the order of the columns is updated.

6 Define folders for the CDE

The naming standard used to define the CDE applies to all Project folders that don't already contain documents. However, you can refine the list of folders the naming standard applies to by selecting and deselecting folders on an individual basis.

7 Set your upload rules

The upload rules determine what happens to documents that are uploaded to a folder with the naming standard enforced. When documents that don't conform to the naming standards are uploaded, it can result in incorrect behaviours. Non-conformance can result from file names that don't match the naming convention.

8 Define how uploaded documents are handled

When you upload documents to a folder with naming standards applied, your files must conform to that naming standard. As described in the Upload Rules, the behaviour for non-conforming files can vary. If a holding area is enabled, any non-conforming files are identified upon upload. Specific errors associated with each file are highlighted.

If the holding area is enabled, you can choose to upload the files to the holding area. Project administrators can access the holding area to fix any files with non-conforming names later. For a step-by-step guide to uploading documents to a CDE, visit our help sites for [Autodesk BIM 360 Docs](#) and [Autodesk Docs](#).



Pro tips:

When you're setting up your folders, consider the following questions:

- Which participants on your project will be using the folders?
- What folders do you need? Consider a 'work-in-progress' folder, a 'shared' folder and a 'publish' folder.
- How will individuals access these folders?

Using the holding area

The holding area lists any upload groups that contain non-conforming files. Open any upload group to edit the fields of the naming convention or attributes to remove the errors. The holding area is available to project admins to view and correct any files uploaded to the project.

For a step-by-step guide on using the holding area, visit the help sites for [Autodesk BIM 360 Docs](#) and [Autodesk Docs](#).



In summary

Why implement ISO 19650?

The ISO 19650 series of standards defines the collaborative processes for managing information over the whole lifecycle of a built asset using BIM. Implementing ISO 19650 standards enables project teams to:

- Build a cohesive way to share, publish and review design and construction documentation
- Ensure that all parties have access to the most up-to-date information when they need it
- Improve the productivity of team members by reducing the time spent searching for information
- Promote better, more informed decision-making
- Minimise costly rework caused by poor project data and miscommunication
- Increase predictability around cost and time
- Maintain security by providing team members with access to information on a need-to-know basis
- Stem data loss at project closeout



How can Autodesk help with ISO 19650?

Autodesk solutions and workflows can help project teams support two of ISO 19650's key concepts and principles:



Container-based collaborative working



CDE solution and workflow



Autodesk BIM 360 Docs and Autodesk Docs can help project teams establish a CDE that meets ISO 19650 standards with regards to:



Functionality

Much of the functionality required by ISO 19650 is supported by Autodesk BIM 360 Docs and Autodesk Docs workflows.



Access control

Autodesk BIM 360 Docs and Autodesk Docs allow access to be granted at the folder level, with permissions from 'view only' to 'full control' as needed.



Authorisation controls

Reviewers and approvers are specified by the initiator, and once the process is complete, the information container can transition from one state to the next.

Want to learn more?

Visit the [ISO 19650 workflow site](#) for more information about how to create a CDE with Autodesk BIM 360 Docs or Autodesk Docs.

Visit Autodesk Website >



i. Emerson, Operational Readiness for New Assets, Nov 2018

ii. JBKnowledge, Inc., Construction Technology Report

iii. FMI+PlanGrid iv. FMI + PlanGrid

This guide extensively cross-references ISO 19650 standards. Visit the [BSI ISO 19650 webpages](#) to find out more and purchase the full standards documents.



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