Connected data environment for digital twins

The first step towards industry data standards and the introduction of connected data environment

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Content

What is a digital twin?

It is a digital representation of something that exists in the physical world (a building, factory, power plant or city), dynamically connected to reality by sensors collecting data in real time. It is this active connection to reality that distinguishes digital twins from digital models created by BIM software.

Digital twin is a dynamic digital reflection of a real-world object or system, so it has operational and behavioral awareness. As a result, it can be used in many ways - to monitor operations, identify problems, simulate results or optimize processes. As digital twins become more commonplace, their historical operational data will support decision-making on new projects and facility upgrades[1].

In this sense, the digital twin represents a single shared source of information. This digital unification starts from the initial design and continues throughout construction and/or production, delivery, handover and the entire product life cycle. As such, shared data environment is essential for the creation and use of digital twins.

> **Digital twins are digital representations of something physical or intangible**
>
> such as a system, process or object (physical twin). A digital twin is more than just a model of a physical asset; it provides context (i.e. the relationship between the asset and its environment), a link between the digital asset and the physical asset (in at least one direction), and the ability to monitor the physical system in a timely manner.
>
> **Hetherington, J., & West, M. (2020)**
> The pathway towards an Information Management Framework – A "Commons" for Digital Built Britain, www.doi.org/10.17863/CAM.52659

[1]Please note that in this document the word "facility" is used as a generic term for a physical, real-world version of a digital twin (building, infrastructure system, power plant, etc.).

What is a shared data environment?

The Common Data Environment (CDE) describes information management processes supported by CDE technology, which, among other things, collects, manages and disseminates relevant asset data. The CDE acts as a digital hub where information is collected and linked throughout the asset lifecycle (from design and production to use and decommissioning).

Representation of the CDE as an agreed source of information (according to ISO 19650 [2]) helps to ensure that information is continuously and systematically updated and supplemented during the managed process.

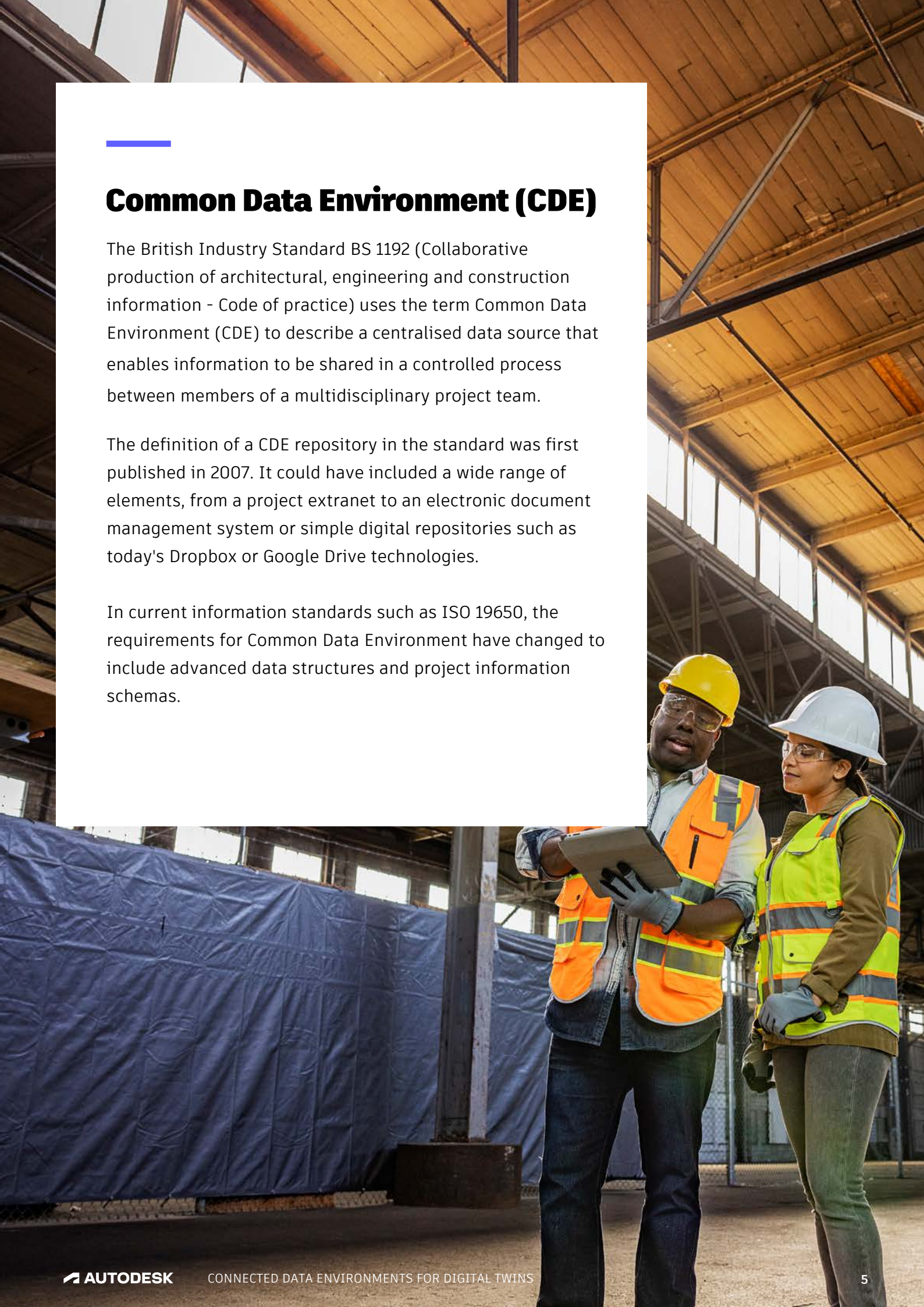
The concept of CDE for the collaborative production of architectural, engineering and construction information was first popularised by the British Standard BS1192:2007. CDE was a core concept of the UK's BIM Level 2 mandate, which came into force in 2016 and is now the basis of the ISO 19650 series.

CDE goes beyond BIM data and information to include everything from contracts, reports and specifications to warranty and service data. It also has features for tracking workflows such as approvals, requests for information (RFIs) and change orders. Collaboration solutions that support the CDE process have evolved since their first use in the late 1990s from extranet file retrieval systems to today's cloud-based shared data environments built on secure data and functionality platforms.

How does this relate to the digital twin?
Its value depends directly on the data: design, manufacturing, installation, operation, performance, etc. It also includes the ability to collect and share pooled data according to standards (e.g. ISO 19650) to organize structured information about the project and, ultimately, the asset.

In short, the creation of a digital twin is based on industry shared data environments that combine CDE project outputs with other asset data sources while meeting advanced technology and data management standards.

[2] ISO 19650 is series of international standards for information management using BIM in construction and engineering projects.



Common Data Environment (CDE)

The British Industry Standard BS 1192 (Collaborative production of architectural, engineering and construction information - Code of practice) uses the term Common Data Environment (CDE) to describe a centralised data source that enables information to be shared in a controlled process between members of a multidisciplinary project team.

The definition of a CDE repository in the standard was first published in 2007. It could have included a wide range of elements, from a project extranet to an electronic document management system or simple digital repositories such as today's Dropbox or Google Drive technologies.

In current information standards such as ISO 19650, the requirements for Common Data Environment have changed to include advanced data structures and project information schemas.

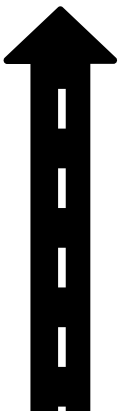
The maturity of a digital twin

Like many other technological innovations, digital twins are the subject of hopes and dreams. Gartner, a US-based research and consulting firm, sees them as part of a cycle of aspiration: a potential technological breakthrough reaches a peak of expectation, only to fall to a level of disappointment before rebounding and maturing into a productive technology.

However, what is often missing from the discussion is the maturity of the digital twin. How to think about it? Good example is an autonomous car. Some of us already have cars with advanced systems such as cruise control or parking assistance. But, they are far from the vision of a car that drives itself.

The following figure shows a simple categorization of the 3 evolutions of a digital twin depending on the added intelligence: starting with a descriptive twin (essentially a pre-digital twin representing the context of the object "as built") and evolving to an autonomous twin (with the ability to learn and act on behalf of users).

Most of today's digital twin efforts focus on developing a baseline - a descriptive twin. Achieving this requires organizational commitment to data standards and oversight. This relates to the importance of structured data that conforms to industry-accepted data standards and the use of common data environments.



Predictive:
provides predictive maintenance, analysis and insight

Autonomous:
uses knowledge from various data sources and the environment to make independent decisions

Descriptive:
an editable version of the design and construction data that represents the condition of the building as it was built

Informative:
integrated with sensors, information technology, business software systems, maintenance and operational data

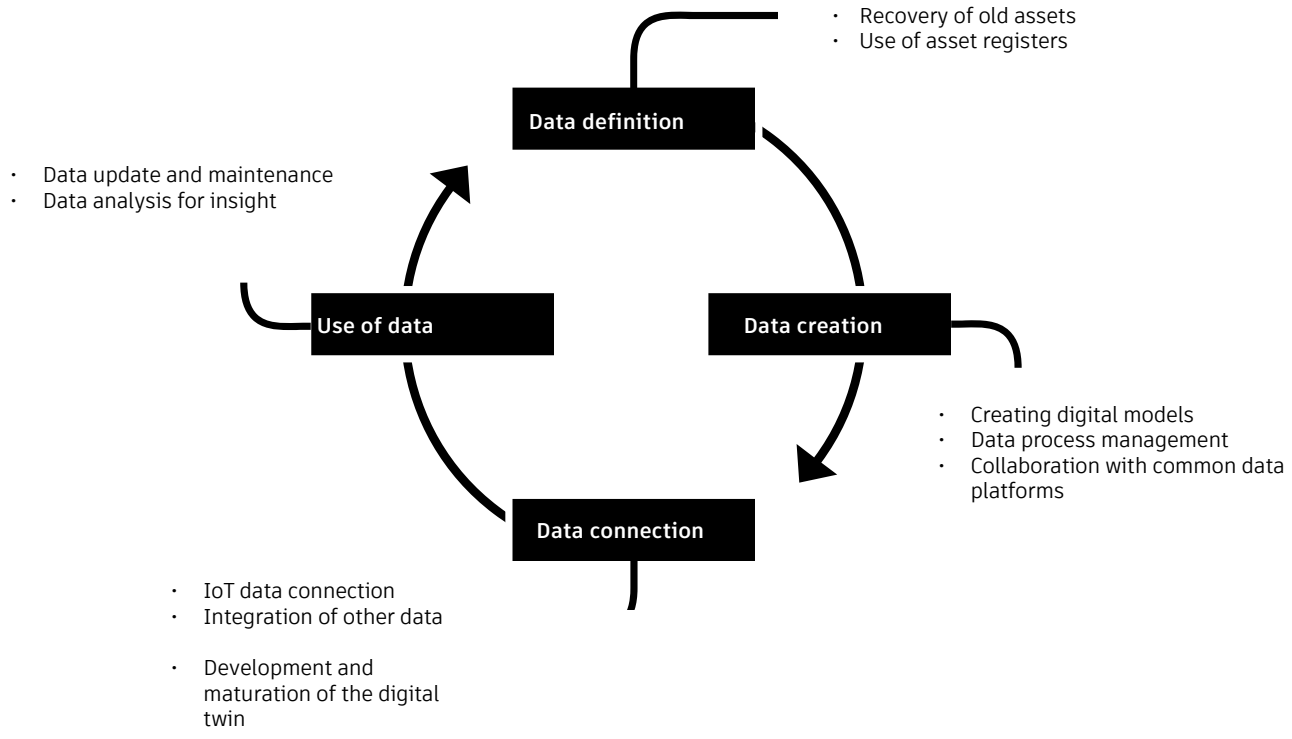
[3] Note that there is currently no consensus in the industry on the names and definitions of digital twin maturity levels, and those currently in use are often taken from descriptions related to data analytics and artificial intelligence. More advanced descriptions of digital twin maturity can be found in the Arup and Verdantix resources at the end of this document.

Linked and structured data: an essential element for digital twins

Creating a descriptive digital twin requires the collection of multiple sources of construction data: 3D models from BIM processes, 2D construction documents, plans and drawings (which remain standard products of industry contracts), geospatial data, as well as submittals, change orders, requests for information (RFIs), schedules, and contracts.

Even today, project teams spend a lot of time entering information into files that is not useful to the owner; sometimes the information is wrong, sometimes there is too little, and in some cases there is an excess of unnecessary data. The transfer of unstructured data leaves owners/operators overloaded with data and systems, inaccurate information, and limited visibility into asset performance. Data-related standards such as ISO 19650 directly address this issue.

The industry is already reaping the benefits of digitalisation during construction. The next step is to implement data standards and a Common Data Environment (CDE) to organise structured data to create a digital twin (see figure below).



The project sponsor´s requirements for structured data are critical for the development of the digital twin. The implementation of a project CDE helps to ensure that data and information is managed and flows easily between different teams and phases of the project through to completion and handover. Integrated shared data environments can then use this approved project data, along with other asset information sources, as the basis for a high quality 'descriptive' digital twin.

Going beyond the descriptive digital twin requires the input of traffic data. This involves the integration of data collected by embedded system sensors (such as IoT devices) and relies heavily on data from the cloud and bespoke system integration efforts. The importance of structured data and adherence to information standards is a prerequisite for success.

> **Data is at the heart of many new technologies. CEOs planning their IT investment strategies should consider a concerted effort to manage and monitor data to ensure the success of digital strategies.**

Alia Mendonsa, Senior Director of Analytics at Gartner Comments Off on Adding Digital Twins in 2019 To Gartner's Cycle of Interest in Digital Government Technology

Digital twin benefits

Digital twins help owners and operators better understand, manage and optimise their assets. Real-world conditions and operational data contained in the digital twin lead to more informed decisions and better performance. Equipment performance simulations increase predictability and reduce risk. Comparing actual operations with historical data provides predictive insight into performance and safety.

The benefits of digital twins relate to the operation (and ultimately the closure) of the facility. As it is widely recognised that the cost of running a facility far exceeds the cost of building it, the benefits of digital twins are enjoyed by owners, operators and (in the case of government-funded facilities) the general public. Fruthermore, the benefits of digital twins can exceed the cost of physically managing the facility. They can lead to safer and healthier working environments, reduced environmental impact, more efficient public services and better informed policy decisions.

Anyone considering investing in digital twins should start by identifying the benefits that can be derived. For example, an asset owner who is struggling to manage a built portfolio can see the consequences of poor asset data management and reactive operational maintenance.

Moving to a digital twin environment can improve understanding of the current situation, help predict failures, and avoid failures by testing simulations. Similarly, a plant owner who understands its network assets but has a significant investment in their operation can use a digital twin to make decisions about extending system automation. He or she can reduce ongoing costs, improve efficiency and increase customer satisfaction.

Conclusion

The possibilities of digital twins are enticing. Data-rich digital twins have the potential to simplify asset management and provide owners with new information to help with decision-making and planning.

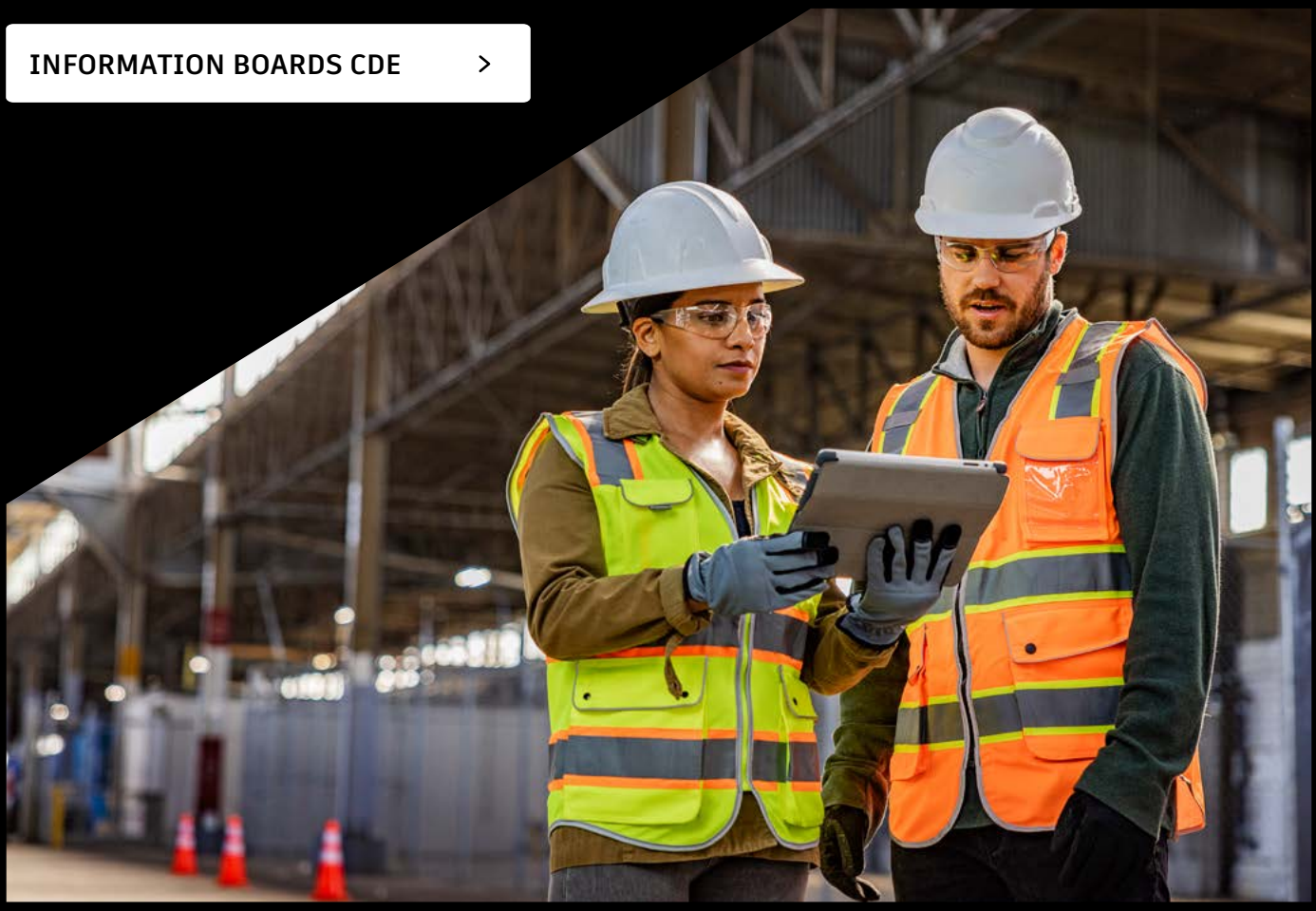
While new information continues to emerge about digital twin technologies and their use in the industry, it is clear that the ultimate success of digital twins depends on combined, shared and structured data sources based on current information management standards.

Therefore, the first step towards digital twins is to adopt industry data standards and establish common data environments that link all aspects of device data as it is created.

Learn more about shared data environments for digital twins

For more information about Autodesk's CDE and digital twin solutions, visit Autodesk BIM 360, Autodesk Tandem, and CDE Dashboard:

INFORMATION BOARDS CDE >



Read more

- Centre for Digital Built Britain This Gemini Principles document proposes principles to guide a national digital twin and an information governance framework to enable this: cdbb.cam.ac.uk/DFTG/GeminiPrinciples

- The pathway towards an information management framework A 'Commons' for Digital Built Britain, CDBB, May 2020: doi.org/10.17863/CAM.52659

- Digital Twin, towards a meaningful framework, Arup, November 2019. arup.com/digitaltwinreport

- Verdantix, digital twin levels verdantix.com/newsroom

- Gartner Group, Gartner Hype Cycle for Digital Government Technology (Hype Cycle pro digitální vládní technologie) (Gartner Hype Cycle for Digital Government Technology) gartner.com/smarterwithgartner

- Autodesk Construction Blog: constructionblog.autodesk.com/digital-twin

- DNV GL: Digital twin in the oil and gas industry: How far have we come? (Digital twin in oil and gas: what have we achieved?). blogs.dnvgl.com

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