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## Automation systems and integration — Digital Twin framework for manufacturing —

### Part 2: Reference architecture

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## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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

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A list of all parts in the ISO 23247 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](http://www.iso.org/members.html).

## Introduction

The ISO 23247 series defines a framework to support the creation of Digital Twins of observable manufacturing elements including personnel, equipment, materials, manufacturing processes, facilities, environment, products, and supporting documents.

The scopes of the four parts of this series are defined below:

- Part 1: Overview and general principles

General principles and requirements for developing a Digital Twin in manufacturing;

- Part 2: Reference architecture

Reference architecture with functional views;

- Part 3: Digital representation of manufacturing elements

List of basic information attributes for observable manufacturing elements;

- Part 4: Information exchange

Technical requirements for information exchange between entities within the reference architecture.

The framework is targeted to all types of manufacturing including discrete and continuous manufacturing of parts, assemblies, and material. The actual type of manufacturing supported by a particular implementation depends on the standards and technologies available to model the observable manufacturing elements.

Digital Twin use cases that conform to the framework will be detailed in a series of technical reports attached to this series. Preliminary outlines for three use cases are given in the Annex of Part 4.

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# Automation systems and integration — Digital Twin framework for manufacturing —

## Part 2: Reference architecture

### 1 Scope

This part of ISO 23247 provides a reference architecture for the Digital Twin in manufacturing.

The ISO 23247 series defines a framework to guide the creation of Digital Twins of observable manufacturing elements including personnel, equipment, materials, processes, facilities, environment, products, and supporting documents.

The following are within the scope of this part of ISO 23247:

- reference architecture goals and objectives;
- reference model;
- functional view.

The following are described in other parts of ISO 23247:

- overview and general principles (Part 1);
- digital representation of manufacturing elements (Part 3);
- information exchange requirements for Digital Twins (Part 4).

The following are outside of the scope of ISO 23247, but will be identified as use cases in technical reports.

- selection of the manufacturing devices and other resources to be represented by Digital Twins;
- selection of the manufacturing processes to be represented by Digital Twins;
- selection of the manufacturing products to be represented by Digital Twins.

### 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 23247-1, *Automation systems and integration — Digital Twin framework for manufacturing — Part 1: Overview and general principles*

ISO/IEC 30141, *Internet of Things (IoT) — Reference Architecture*

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 23247-1 and the following apply.

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

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

### 3.1

#### **Observable Manufacturing Domain**

spatial/logical/functional area of the observable manufacturing resources

### 3.2

#### **Observable Manufacturing Element**

item that has observable physical presence or operation in manufacturing

[SOURCE: ISO 23247-1, 3.2.5]

EXAMPLE Resources of a machine tool such as cutters, fixtures, and moving components

### 3.3

#### **Data Collection and Device Control Domain**

spatial/logical/functional area that uses sensors to collect data from the Observable Manufacturing Domain and provides services to monitor the manufacturing process and control the manufacturing devices

### 3.4

#### **Data Collection and Device Control Entity**

(set of) system(s) or device(s) providing data collection and device control

EXAMPLE The computerized numerical control of a machine tool

### 3.5

#### **Core Domain**

spatial/logical/functional area that provides management functionalities for Digital Twins including visualization, presentation, synchronization, historical archiving, data analytics, simulation, and optimization

### 3.6

#### **Core Entity**

(set of) system(s) providing functionalities for the Digital Twins such as realisation, management, synchronization, and simulation

EXAMPLE A system providing simulation, synchronization, and data analytics for a manufacturing cell

### 3.7

#### **User Domain**

spatial/logical/functional area utilizing applications and services provided by the Core Domain

### 3.8

#### **User Entity**

human users, applications, and systems that use the services provided by the Core Entity

EXAMPLE An ERP system that uses the APIs provided by a Digital Twin application to update the current status of resources in its database

## 4 Digital Twin reference architecture: goals and objectives

The Digital Twin reference architecture provides guidance for managing Digital Twins in manufacturing. The architecture increases understanding of Digital Twins for stakeholders including device manufacturers, application developers, and users.

The Digital Twin reference architecture is based on the Internet of Things (IoT) reference architecture defined in ISO/IEC 30141, which provides guidance for the architect developing an IoT system and aims



to give a better understanding of IoT systems to the stakeholders of such systems, including device manufacturers, application developers, customers and users.

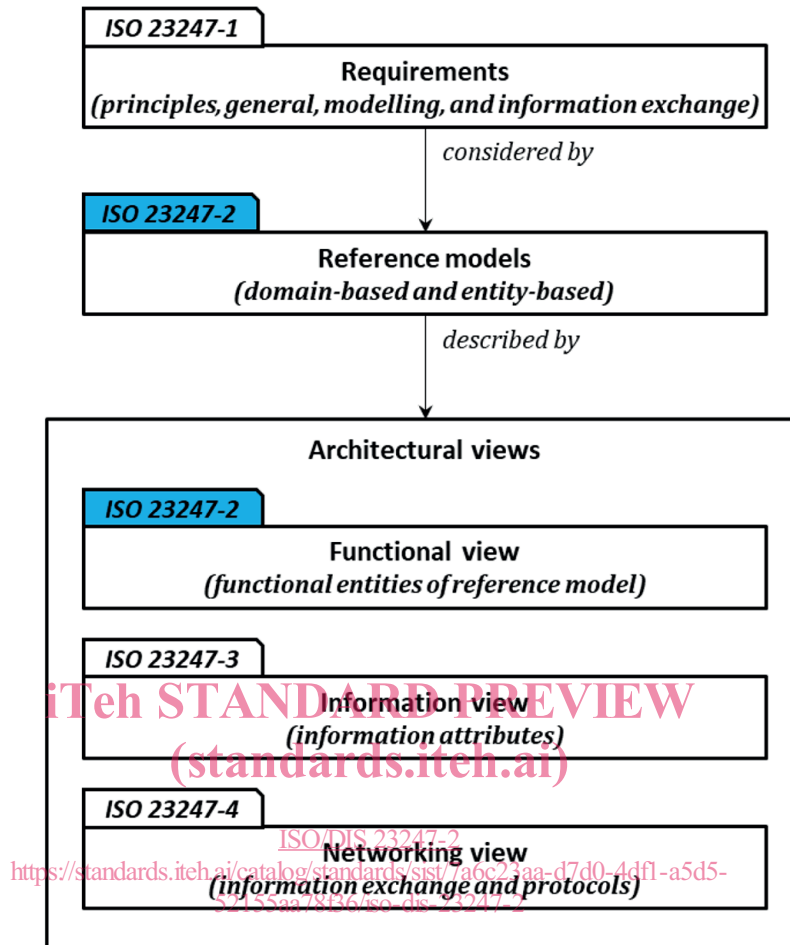


Figure 1 — Outline of Digital Twin reference architecture for manufacturing

Figure 1 shows the reference models and architectural views defined by the reference architecture.

The architecture defines the following extensions to the descriptions contained in ISO/IEC 30141:

- domain-based and entity-based reference models for Digital Twins in manufacturing;
- functional view for Digital Twins in manufacturing.

## 5 Digital Twin reference models for manufacturing

### 5.1 Domain-based reference model

#### 5.1.1 Domains of Digital Twin for manufacturing

Figure 2 shows a domain-based reference model for Digital Twins in manufacturing. A domain-based reference model is useful to describe various tasks that have to be performed in separate areas, by allowing a logical and sometimes physical subdivision. In other words, domains are used to sort functions into areas of responsibility.