FINAL DRAFT

INTERNATIONAL STANDARD

ISO/FDIS 23247-1

Automation systems and integration — Digital twin framework for manufacturing —

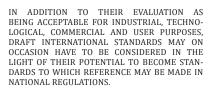## Part 1:
Overview and general principles

Systèmes d'automatisation industrielle et intégration — Cadre technique de jumeau numérique dans un contexte de fabrication —

Partie 1: Vue d'ensemble et principes généraux

Reference number
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Contents

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ISO/FDIS 23247-1
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eaba332a9ffc/iso-fdis-23247-1

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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This document was prepared by Technical Committee ISO/TC 184, *Automation systems and integration*, Subcommittee SC 4, *Industrial data*.

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.

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.

A digital twin assists with detecting anomalies in manufacturing processes to achieve functional objectives such as real-time control, predictive maintenance, in-process adaptation, Big Data analytics, and machine learning. A digital twin monitors its observable manufacturing element by constantly updating relevant operational and environmental data. The visibility into process and execution enabled by a digital twin enhances manufacturing operation and business cooperation.

The type of manufacturing supported by an implementation of the ISO 23247 framework depends on the standards and technologies available to model the observable manufacturing elements. Different manufacturing domains can use different data standards. As a framework, this document does not prescribe specific data formats and communication protocols.

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

— ISO 23247-1: General principles and requirements for developing digital twins in manufacturing;

— ISO 23247-2: Reference architecture with functional views;

— ISO 23247-3: List of basic information attributes for the observable manufacturing elements;

— ISO 23247-4: Technical requirements for information exchange between entities within the reference architecture.

Figure 1 shows how the four parts of the series are related.

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ISO 23247-1
┌─────────────────────────────────────────────┐
│ Principles                                    │
│ (concept, limitations and boundaries,         │
│  requirements)                                │
└─────────────────────────────────────────────┘
                    │ considered by
                    ▼
ISO 23247-2
┌─────────────────────────────────────────────┐
│ Reference models                              │
│ (domain-based and entity-based)               │
└─────────────────────────────────────────────┘
                    │ described by
                    ▼
┌─────────────────────────────────────────────┐
│ Framework views                               │
│  ISO 23247-2                                  │
│  ┌─────────────────────────────────────────┐ │
│  │ Functional view                          │ │
│  │ (functional entities of reference model) │ │
│  └─────────────────────────────────────────┘ │
│  ISO 23247-3                                  │
│  ┌─────────────────────────────────────────┐ │
│  │ Information view                         │ │
│  │ (information attributes)                 │ │
│  └─────────────────────────────────────────┘ │
│  ISO 23247-4                                  │
│  ┌─────────────────────────────────────────┐ │
│  │ Networking view                          │ │
│  │ (information exchange and protocols)     │ │
│  └─────────────────────────────────────────┘ │
└─────────────────────────────────────────────┘
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Figure 1 — ISO 23247 series structure

ISO 23247-4:—[1]), Annexes A to E, provide use cases that demonstrate the digital twin framework for manufacturing. The use cases are in the discrete manufacturing domain and the digital twins are modelled using the ISO 10303 series. In other domains, different standards and technologies can be used. For example, in the oil and gas industry, digital twins may be modelled using the ISO 15926 series, and for building and construction, digital twins may be modelled using the ISO 16739 series.

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1) Under preparation. (Stage at the time of publication: ISO/FDIS 23247-4:2021.)

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Automation systems and integration — Digital twin framework for manufacturing —

Part 1: Overview and general principles

1 Scope

This document provides an overview and general principles of a digital twin framework for manufacturing including:

— terms and definitions;

— requirements of the digital twin framework for manufacturing.

2 Normative references

There are no normative references in this document.

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3 Terms, definitions and abbreviated terms

For the purposes of this document, the following terms and definitions 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 General terms

3.1.1
control
purposeful action on or in a process to meet specified objectives

[SOURCE: IEC 60050:2013, 351-42-19, modified — The Notes to entry have been removed.]

3.1.2
element
basic system part that has the characteristics of state, behaviour, and identification

[SOURCE: ISO 14258:1998, 2.2.4]

3.1.3
enterprise
one or more organizations sharing a definite mission, goals, and objectives which provides an output such as a product or service

[SOURCE: IEC 62264-1:2013]

3.1.4
entity
anything (physical or non-physical) having a distinct existence

[SOURCE: ISO/IEC 15459-3:2014, 3.1, modified — The Note to entry has been removed.]

3.1.5
Internet of Things
IoT
infrastructure of interconnected entities, people, systems and information resources together with services which processes and reacts to information from the physical and virtual world

[SOURCE: ISO/IEC 20924:2021]

3.1.6
management
direction, *control* (3.1.1), and coordination of work performed to develop a product or perform a service

[SOURCE: ISO/IEC/IEEE 24765:2017, 3.3064, modified — In the term, "process" has been removed.]

3.1.7
physical element
thing that has material existence

3.1.8
resource
any device, tool and means, except raw material and final product components, at the disposal of the *enterprise* (3.1.3) to produce goods or services

Note 1 to entry: Resources, as they are defined here, include human resources.

[SOURCE: ISO 15531-1:2004, 3.6.43, modified — Note 1 has been modified. Note 2 has been deleted.]

3.1.9
sensor
device that observes and measures a physical property of a natural phenomenon or process and converts that measurement into a signal

[SOURCE: ISO/IEC 29182-2:2013, 2.1.5, modified — "man-made" has been removed and Note 1 to entry has been deleted.]

3.1.10
universally unique identifier
UUID
computer-generated identification that, for practical purposes, is unique

3.2 Terms related to digital twin for manufacturing

3.2.1
digital identification method
<manufacturing> method selected to identify each *OME* (3.2.5) and its digital twin

Note 1 to entry: Twins can be identified using *UUIDs* (3.1.10), part numbering or some other mechanism.

3.2.2
digital representation
<manufacturing> data element representing a set of properties of an *observable manufacturing element* (3.2.5)

[SOURCE: IIC:PUB:G8V2.1:PB:20180822, modified — In the definition, "physical element" has been replaced with "observable manufacturing element".]

3.2.3
digital twin
<manufacturing> fit for purpose *digital representation* (3.2.2) of an observable manufacturing element with synchronization between the element and its digital representation

3.2.4
manufacturing process
set of processes in manufacturing involving a flow and/or transformation of material, information, energy, control, or any other element in a manufacturing area

[SOURCE: ISO 18435-1:2009, 3.16, modified — Note 1 to entry has been deleted.]

3.2.5
observable manufacturing element
OME
item that has an observable physical presence or operation in manufacturing.

Note 1 to entry: Observable manufacturing elements include personnel, equipment, material, process, facility, environment, product, and supporting document.

3.2.6
presentation
manner in which information is displayed for use by a human

Note 1 to entry: Information can be presented in any way that human can sense.

[SOURCE: ASME Y14.47-2019, modified — Note 1 to entry has been modified.]

3.2.7
representation
manner in which information is modelled for interpretation by a machine

[SOURCE: ASME Y14.47-2019, modified — In the definition, "stored" has been changed to "modelled".]

3.2.8
view
viewpoint
projection of a model, from a given perspective, which omits entities that are not relevant to this perspective

[SOURCE: ISO/IEC 19501:2005, 000_3, modified — In the definition "which is seen" has been removed before "from"; "or a vantage point and" has been removed after "perspective".]

3.3 Abbreviated terms

CAD computer aided design

CAI computer aided inspection

CAM computer aided manufacturing

CNC computerized numerical control

4 Overview of digital twin for manufacturing

4.1 Concept of the digital twin for manufacturing

A digital twin in manufacturing is a fit for purpose digital representation of an observable manufacturing element with synchronization between the element and its digital representation.