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Automation systems and integration — Digital Twin framework for manufacturing —

Part 1:
Overview and general principles

ICS: 25.040.40; 35.240.50

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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 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.

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

— Part 1: Overview and general principles

General principles and requirements for developing Digital Twins in manufacturing;

— Part 2: Reference architecture

Reference architecture with functional views;

— Part 3: Digital representation of manufacturing elements

List of basic information attributes for the 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.

Automation systems and integration — Digital Twin framework for manufacturing —

Part 1: Overview and general principles

1 Scope

This part of ISO 23247 provides an overview and general principles of a Digital Twin for 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:

— scope statement for ISO 23247 as a whole;

— terms and definitions used throughout ISO 23247;

— overview and requirements of the Digital Twin framework for manufacturing.

The following are described in other parts of ISO 23247:

— reference architecture (Part 2);

— digital representation of manufacturing elements (Part 3);

— information exchange requirements for Digital Twins (Part 4).

The following are outside 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

There are no normative references in this document.

3 Terms and definitions

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 http://www.electropedia.org/

3.1 General terms

3.1.1
actuator
device that provides a physical output in response to an input signal in a predetermined way

[SOURCE: ISO/IEC 29182-2]

3.1.2
control
purposeful action on or in a process to meet specified objectives

[SOURCE: IEV 351-42-19]

3.1.3
element
basic system part that has the characteristics of state, behaviour, and identification

[SOURCE: ISO 14258:1998, 2.2.4]

3.1.4
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]

3.1.5
entity
thing (physical or non-physical) having a distinct existence

[SOURCE: ISO/IEC 15459-3:2014, 3.1]

3.1.6
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 20924:2018]

3.1.7
management
direction, control, and coordination of work performed to develop a product or perform a service

[SOURCE: ISO/IEC/IEEE 24765:2017, 3.3064]

3.1.8
physical element
thing that has material existence in physical world

3.1.9
resource
any device, tool, and means, except raw material and final product components, at the disposal of the enterprise 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. Note 1 has been modified. Note 2 has been deleted.]

3.1.10
sensor
device that observes and measures a physical property of a natural phenomenon or man-made process and converts that measurement into a signal

[SOURCE: ISO/IEC 29182-2. Note 1 to entry has been deleted.]

3.1.11
task
activities required to achieve a goal

Note 1 to entry: These activities can be physical and/or cognitive.

[SOURCE: ISO 9241-11:1998, 3.9]

3.2 Digital Twin for manufacturing specific terms

3.2.1
digital representation
<manufacturing> data element representing a set of properties of an observable manufacturing element

[SOURCE: IIC:PUB:G8V2.1:PB:20180822, modified, physical element has been replaced to observable manufacturing element]

3.2.2
Digital Twin
<manufacturing> fit for purpose digital representation of an observable manufacturing element with a means to enable convergence between the element and its digital representation at an appropriate rate of synchronisation

3.2.3
Digital Twin modelling
procedure of creating a Digital Twin of an observable manufacturing element

3.2.4
manufacturing process
structured set of activities or operations performed upon material to convert it from the raw material or a semi-finished state to a state of further completion

Note 1 to entry: Manufacturing processes may be arranged in process layout, product layout, cellular layout or fixed position layout. Manufacturing processes may be planned to support make-to-stock, make-to-order, assemble-to-order, etc., based on strategic use and placements of inventories.

[SOURCE: ISO 15531-1:2004, 3.6.25]

3.2.5
observable manufacturing element
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 audibly and visually.

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