FINAL
DRAFT

INTERNATIONAL
STANDARD

**ISO/FDIS
23247-3**

ISO/TC **184**/SC **4**

Secretariat: ANSI

Voting begins on:
2021-06-18

Voting terminates on:
2021-08-13

Automation systems and integration — Digital twin framework for manufacturing —

Part 3: Digital representation of manufacturing elements

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

Partie 3: Représentation numérique des éléments intervenant en fabrication

Reference number
ISO/FDIS 23247-3:2021(E)

COPYRIGHT PROTECTED DOCUMENT

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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.

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.

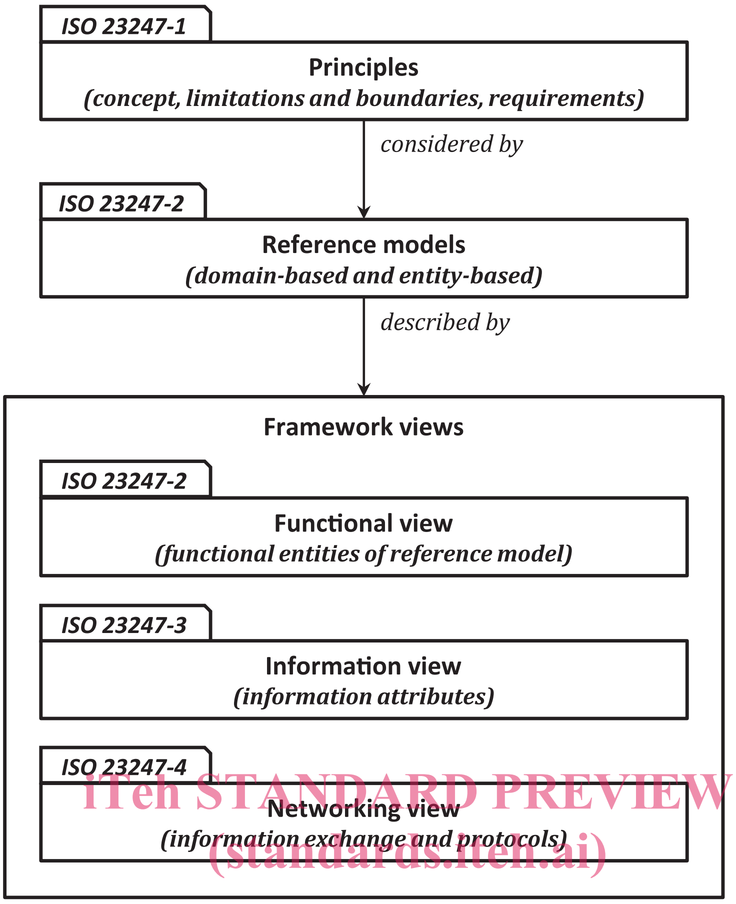

Figure 1 — ISO 23247 series structure

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 oil and gas, the digital twins may be modelled using the ISO 15926 series, and for building and construction, the digital twins may be modelled using the ISO 16739 series.

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

Automation systems and integration — Digital twin framework for manufacturing —

Part 3: Digital representation of manufacturing elements

1 Scope

This document provides a list of basic information attributes for the OMEs:

— examples of information attributes are given;

— standards that can define these information attributes are discussed in Annex A.

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*

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:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
information attribute
information about observable manufacturing elements (OMEs)

3.2
dynamic
<information attribute> *information attribute* (3.2) that changes during manufacturing processes

3.3
static
<information attribute> *information attribute* (3.2) that does not change during manufacturing processes

3.4
mandatory
<information attribute> *information attribute* (3.2) that must be included in any description of the OME

3.5
optional
<information attribute> *information attribute* (3.2) that may be included in a description of the OME depending on the purpose

4 Digital representation of OMEs

Digital representation of OMEs can include both static and dynamic information. Information that does not change during manufacturing is classified as static. For example, the serial number of a piece of material is static. However, the shape of the material, if it changes during manufacturing processes, is dynamic.

Pursuant to the principles defined in ISO 23247-1, this document provides a list of basic information attributes for the OMEs within the reference architecture given in ISO 23247-2.

The blue-coloured box in Figure 2 shows the types of OMEs that need to be represented by the digital twin entity defined in ISO 23247-2.

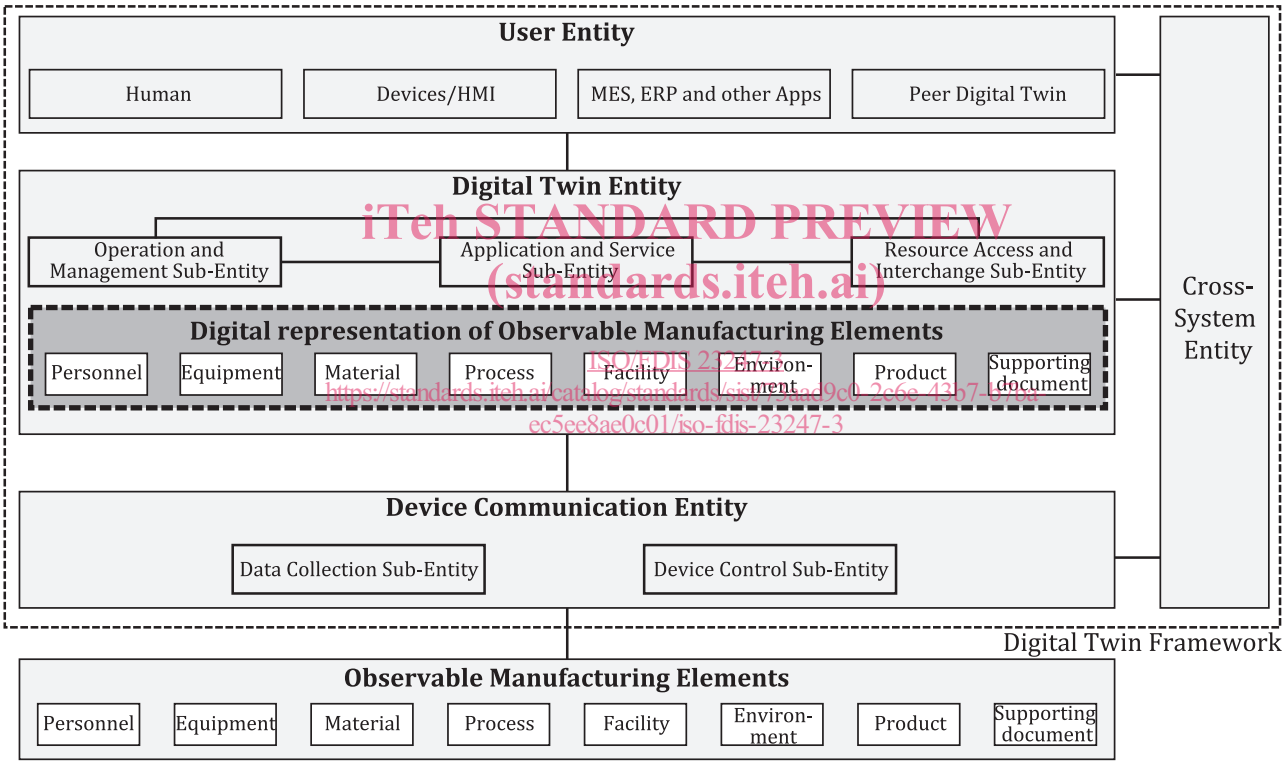

Figure 2 — Types of OMEs in reference architecture (blue-coloured box)

5 Information attributes of the OMEs

5.1 General

Standards such as IEC 62264-2, ISO 10303-238 and ISO 10303-242 contain detailed information models for representing the OMEs. Each implementation of the digital twin framework for manufacturing shall select the digital representation method most appropriate to model its OMEs.

Annex A lists some standards and technologies that can be selected for the digital representation. Annex B provides UML and XML descriptions for an example.

Table 1 shows the template used to describe the information attributes. The types of information attributes are not limited to those given in Table 1, but can be customized for specific use cases. The notation is taken from IEC 62264-2. Mandatory (M) or Optional (O) attributes can be selected depending on the purpose of the use cases.

Table 1 — Information attributes for OMEs

Information attribute	Description	Mandatory (M) Optional (O)
Identifier	A value that conforms to ISO 8000-115 used to uniquely identify an OME in a specific enterprise, e.g.: — UUID (ITU-T Rec. X.667 | ISO/IEC 9834-8) — URL — URN (IETF RFC 4122) — OID(ITU-T X.680 and ISO/IEC 8824-1) — domain-specific ID — ISO 29002 series or URI unique ID (used in AAS)	Mandatory
Characteristics	A typical or noticeable feature of an OME, e.g.: — IEC 62264-2 (B2MML) — eCl@ss — ISO 13584-42 (PLIB) — IEC 61360 (CDD)	Optional depending on the purpose of the use cases
Schedule	Time information bound to a manufacturing process, e.g.: — ISO 8601 series — start/stop	
Status	A condition of an OME involved in a manufacturing process, e.g.: — VDMA 24582	
Location	Geographical or relative location information of an OME, e.g.: — GPS coordinates — postal address — ISO 6709 — relative location	
Report	Description of activities done by or onto an OME, e.g.: — QIF — MTConnect	
Relationship	Connection information between two or more OMEs, e.g. IEC 62264-2	

5.2 Personnel information

Personnel includes employees who are engaged directly or indirectly in manufacturing processes. Personnel information attributes and examples are shown in Table 2.

Table 2 — Information attributes for personnel

Attribute	Description	Examples
Identifier	A value that conforms to ISO 8000-115 used to uniquely identify the person in a specific enterprise, e.g.: — employee ID — UUID — URL — URN (IETF RFC 4122) — OID(ITU-T X.680 and ISO/IEC 8824-1) — domain-specific ID — ISO 29002 series or URI unique ID (used in AAS)	— employee ID: 11223 — UUID: b2287ac5-9572-4e58-88e5-2ba446c630d7
Characteristics	Personal properties including skill level, classification, e.g.: — IEC 62264-2 — skill level — 1: master — 2: journeyman — 3: apprentice — classification — 1: researcher — 2: administrator — 3: technician — 4: driver	— IEC 62264-2 — skill level: 2 — classification: 3
Schedule	A personal working schedule, e.g.: — ISO 8601 series — working — day-off	— 2019-05-14-working-0800-1700
Status	A current working status	— 2019-05-14-onbreak-1500-1530
Location	location information of a person, e.g.: — GPS coordinates — postal address — ISO 6709 — relative location	— Operator #1: WorkUnit #3 and 50 cm away from Robot #2.
Report	An activity report of a person	— 2019-05-14-8 h of work
Relationship	Information regarding collaborations among personnel and other OMEs	— Operator #1 is the supervisor of operator #2. — WorkUnit #3 must have at least 4 persons for safety reasons. — Operator #1 and Operator #2 are working in the WorkUnit #3. — Operator #1 and Operator #2 are 70 cm away from Machine #2.

5.3 Equipment information

Equipment is a physical element that carries out an operation directly or indirectly for a manufacturing process. Equipment information attributes and examples are shown in Table 3.

Table 3 — Information attributes for equipment

Attribute	Description	Examples
Identifier	A value that conforms to ISO 8000-115 used to uniquely identify the equipment in a specific enterprise, e.g.: — UUID — asset ID	— UUID: e88561dc-2401-4f9a-961c-e90e6424b1dd — asset ID: dtm-200327-11
Characteristics	Functionalities, features of the equipment, e.g.: — milling — turning — grinding — pressing	milling
Schedule	A plan for carrying out manufacturing activities, e.g. Monday to Friday first shift	Maintenance for Machine #1 is scheduled on every Sunday.
Status	A current state of the equipment, e.g.: — on/off — working/breakdown — energy usage (unit: kWh) — temperature (unit: °C, °F) — noise level (unit: dB)	— on — energy usage: 10kWh — temperature: 25 °C
Location	Location information of the equipment, e.g.: — GPS coordinates — postal address — ISO 6709 — relative location	— Relative location — Machine #2: Work Unit #2 in Room #3
Report	An activity report of the equipment engaged in manufacturing, maintenance, etc.	— May 14th, 2019 9 AM to 6 PM: Regular Maintenance — May 14th, 2019 11 AM: Machine #1 reports high temperature.
Relationship	Relationship information between the equipment and other OMEs	— Machine #1 operates with Material #2. — Machine #1 is operated in WorkCenter #5.

5.4 Material information

Material includes physical matter that is transformed to become part or the whole of a product e.g. metal block, glass panel, chemical compound, or is used to aid manufacturing processes such as cleaning fluid or coolant. Material information attributes and examples are shown in Table 4.

Table 4 — Information attributes for material

Attribute	Description	Examples
Identifier	A value that conforms to ISO 8000-115 used to uniquely identify the material in a specific enterprise, e.g.: — UUID — bar code — RFID tag	— UUID: 0030f7a2-5266-4937-9820-168409f5e9a2 — bar code: 8809123456785
Characteristics	Features of the material, e.g.: — handle with care/fragile — toxic/non-toxic — liquid/solid/gas — plastic/steel/rubber/powder	Handle with care
Schedule	Time information of the material, e.g.: — purchase schedule — receiving/internal routing schedule — machine load schedule	Purchase: May 14th, 2019
Status	A current condition of the material, e.g.: — tested — availability — liquid/solid/gas	Tested
Location	Location information of the material, e.g.: — GPS coordinates — postal address — ISO 6709 — relative location	Relative location Material #1: Shelf #3 in Warehouse #2
Report	A usage report of the material	May 14th, 2019: 8 kg of Material #2 was used in WorkUnit #2.
Relationship	Relationship information between the material and other OMEs	Material #1 is operated by an operator with skill level2.

5.5 Process information

A process consists of the operations necessary to complete a manufacturing task, e.g. milling and drilling in discrete manufacturing, distillation and reaction in oil and gas. Process information attributes and examples are shown in Table 5.

Table 5 — Information attributes for a process

Attribute	Description	Examples
Identifier	A value that conforms to ISO 8000-115 used to uniquely identify a process in a specific enterprise, e.g.: — UUID — process identifier	— UUID: fb341a45-942e-4128-9878-89ab1020bca1 — process identifier : proc-20201210221020