IEC 62832-1

Edition 1.0 2020-10

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Industrial-process measurement, control and automation – Digital factory framework –
Part 1: General principles

Mesure, commande et automation dans les processus industriels – Cadre de l'usine numérique (digital factory) –
Partie 1: Principes généraux

IEC 62832-1:2020-10(en-fr)

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

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Industrial-process measurement, control and automation – Digital factory framework – Part 1: General principles

Mesure, commande et automation dans les processus industriels – Cadre de l'usine numérique (digital factory) – Partie 1: Principes généraux

INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

INDUSTRIAL-PROCESS MEASUREMENT, CONTROL AND AUTOMATION – DIGITAL FACTORY FRAMEWORK –

Part 1: General principles

FOREWORD

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International Standard IEC 62832-1 has been prepared by IEC technical committee 65: Industrial-process measurement, control and automation.

This first edition cancels and replaces the first edition of IEC TS 62832-1 published in 2016. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous Technical Specification:

- correction of terms and definition of additional terms (Clause 3);
- correction of description of header;
- moved UML diagram to IEC 62832-2.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
65/836/FDIS	65/845/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 62832 series, published under the general title, *Industrial-process measurement, control and automation – Digital Factory framework* can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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INTRODUCTION

0.1 Market demand and situation

High performance, flexible dynamic processes, and agile machines and production systems are essential to meet the demands for quality, delivery and cost of the products. This situation results in an increased complexity of the plant life cycle. In addition, all existing information of a product or a production system is described and modified through the whole life cycle of a product or of a production system, for example during the planning, development process, and operation. This situation spurs the enterprise to exchange product data and production system data in electronic form.

However, each enterprise and each department inside the enterprise describe their products and production systems according to their own data management schemes, often using different terms, structures, and media.

EXAMPLE Examples for data management schemes are paper-based, databases, disks, e-catalogues, and cloud.

Therefore, no seamless information exchange between all the actors involved in the life cycles of both products and production systems can be found.

Efficient exchange of data between and within enterprises can only be performed if syntax (format) and semantics (meaning) of the information has been defined in a unanimous and shared manner.

0.2 History of standardization in this area

Earlier work on electronic product data started with the initial objective to replace paper data sheets with an electronic description of electronic components used in products, and to use it in software tools for electronic wiring and assembly (for example, when designing electronic boards).

Additionally, concepts were developed for profiling of devices used in production systems, in order to describe parameters and behavioural aspects to facilitate integration and reduce engineering costs, providing guides for standards developers.

NOTE 1 See Device Profile Guideline (IEC TR 62390).

IEC 61987-10 made an important step toward this objective by defining fundamentals that aim at describing devices used in production systems by creating lists of properties (LOPs). The properties themselves are compiled into blocks that describe given features of a device. Further parts of IEC 61987 and other related standards (e.g. IEC 62683 (all parts)) define reference LOPs for electronic/electric components and materials used in electro-technical equipment and systems, such as equipment for measuring flows, pressures, temperatures, levels and densities.

NOTE 2 Although the title of IEC 62683 is "Low-voltage switchgear and controlgear – Product data and properties for information exchange", the intent of IEC 62832 is to use the information exchange for interoperability in describing devices that are used in production systems.

IEC 61360-1, IEC 61360-2 and ISO 13584-42 specify the principles to be used for defining characterization classes of parts and their properties. As a result, a database was developed, also named IEC Common Data Dictionary (IEC CDD), which contains the reference collection of classes and associated properties. ISO 22745 (all parts) specifies open technical dictionaries (OTDs) and their application to master data. ISO/IEC Guide 77 provides recommendations for the description of products and their properties for the creation of these classes, catalogues and reference dictionaries.

NOTE 3 ISO/IEC Guide 77 uses the term "product". It is taken to include devices, processes, systems, installations, etc.

ISO 15704 specifies requirements of enterprise reference architectures and methodologies for supporting the applications in terms of the interoperability, the integration, and the architectures of the applications throughout the life cycle and supply chain aspects of the systems.

A number of efforts have addressed the development of business and manufacturing enterprise models to aid in understanding of different aspects of the enterprise to realize improvements in enterprise operations. Additionally, models for enterprise and control systems have been developed to support the production operations, but gaps remain in development of models to bridge from the manufacturing system design environments to the manufacturing operation environments, in terms of sharing information of the process, equipment, and devices.

NOTE 4 IEC 62264 (all parts) defines models of functions in the manufacturing and control domains and information exchanged with the enterprise domain.

0.3 Purpose and benefits of IEC 62832 (all parts)

While the standards mentioned above provide a method for describing properties of a given device, IEC 62832 (all parts) extends this method by defining a reference model for the representation of production systems, which include the devices.

In order to manage a production system effectively throughout its life cycle, it is very important to have its digital representation and to maintain the contents appropriately in response to its evolution in its life cycle. Activities related to the production system will access, update, and use the contents of digital representation in order to support the whole life cycle of the production system. This digital representation provides a consistent information interchange between all processes and partners involved and makes related information understandable, reusable and changeable through the entire production system life cycle.

Dictionaries and models can help to establish such digital representation by providing descriptions of elements, such as equipment and devices, of the production system. However, additional information is needed in order to achieve the intended digital representation of production systems, such as descriptions of relationship between the elements.

IEC 62832 (all parts) provides a framework for establishing and maintaining the digital representations of production systems, including the elements, relationships between these elements and the exchange of information about these elements.

The framework aims at reducing the interoperability barriers for exchange of information for the various activities related to production systems. The main advantages of this method are that all information related to a production system is described in a standardized manner, and it can be used and modified through its entire life cycle.

The method defined in IEC 62832 (all parts) is kept as generic as possible in order to enable its use in several industrial sectors.

NOTE Enterprise modelling concepts are described in standards referenced in the Bibliography (for example ISO 15704, ISO 11354-1).

0.4 Contents of IEC 62832 (all parts)

IEC 62832 (all parts) consists of multiple parts which provide:

- general introduction to the model and principles of the Digital Factory framework (DF framework) (IEC 62832-1);
- detailed data model for all the model elements of the DF framework (IEC 62832-2);
- description of how the DF framework is used to manage the life cycle of a production system (IEC 62832-3).

INDUSTRIAL-PROCESS MEASUREMENT, CONTROL AND AUTOMATION – DIGITAL FACTORY FRAMEWORK –

Part 1: General principles

1 Scope

This part of IEC 62832 defines the general principles of the Digital Factory framework (DF framework), which is a set of model elements (DF reference model) and rules for modelling production systems.

This DF framework defines:

- a model of production system assets;
- a model of relationships between different production system assets;
- the flow of information about production system assets.

The DF framework does not cover representation of building construction, input resources (such as raw production material, assembly parts), consumables, work pieces in process, nor end products.

It applies to the three types of production processes (continuous control, batch control and discrete control) in any industrial sector (for example aeronautic industries, automotive, chemicals, wood).

NOTE This document does not provide an application scenario for descriptions based on ISO 15926 (all parts), because ISO 15926 (all parts) uses a different methodology for describing production systems.

The representation of a production system according to this document is managed throughout all phases of the production system life cycle (for example design, construction, operation or maintenance). The requirements and specification of software tools supporting the DF framework are out of scope of this document.

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.

IEC 62832-2, *Industrial-process measurement, control and automation – Digital Factory framework – Part 2: Model elements*

IEC 62832-3, *Industrial-process measurement, control and automation – Digital Factory framework – Part 3: Application of Digital Factory for life cycle management of production systems*

IEC 62832 (all parts), *Industrial-process measurement, control and automation – Digital Factory framework*

ISO/IEC 6523 (all parts), *Information technology – Structure for the identification of organizations and organization parts*

ISO/IEC 11179-6, *Information technology – Metadata registries (MDR) – Part 6: Registration*

ISO TS 29002-5:2009, *Industrial automation systems and integration – Exchange of characteristic data – Part 5: Identification scheme*

3 Terms, definitions, abbreviated terms and conventions

3.1 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:

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

3.1.1
activity
group of tasks that are classified as having a common objective

EXAMPLE Electrical wiring design, PLC programming, mounting, wiring, drive configuration, modelling, simulation, monitoring.

[SOURCE: IEC 62264-1:2013, 3.1.1, modified – The example has been added.]

3.1.2
asset
physical or logical object owned by or under the custodial duties of an organization, having either a perceived or actual value to the organization

Note 1 to entry: A role is not an asset.

[SOURCE: IEC TS 62443-1-1:2009, 3.2.6, modified – The note has been replaced.]

3.1.3
classification consortium
group of companies that is working on concept dictionaries

3.1.4
collection of data elements
CDEL
identified and structured set of data elements

3.1.5
concept dictionary
collection of concept dictionary entries that allows lookup by concept identifier

Note 1 to entry: There are standardized dictionaries (e.g. IEC CDD), consortium dictionaries (e.g. eOTD®[1] and eCl@ss®[2]), supplier dictionaries and DF dictionaries.

[SOURCE: ISO TS 29002-5:2009, 3.5, modified – The note has been added.]

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1 eOTD® is the registered trademark of a product supplied by ECCMA (Electronic Commerce Code Management Association). This information is given for the convenience of users of this document and does not constitute an endorsement by IEC of the product named.

2 eCl@ss® is the registered trademark of a product supplied by the eCl@ss e.V. association. This information is given for the convenience of users of this document and does not constitute an endorsement by IEC of the product named.

3.1.6
concept dictionary entry
definition of a concept containing, at a minimum, an unambiguous concept identifier, a preferred name, and a description

[SOURCE: ISO TS 29002-5:2009, 3.3, modified – The terms "identifier" and "term" have been replaced with "concept identifier" and "preferred name" and the note to entry has been deleted.]

3.1.7
data element
unit of data consisting at least of the reference to a data element type and a corresponding value

3.1.8
data element relationship
relationship between data element types or between data elements in a given context

3.1.9
data element type
unit of data for which the identification, description and permissible values have been specified according to a data specification

Note 1 to entry: This definition was derived from both ISO 22745-2:2010, 15.2 and ISO 13584-42:2010, 3.28.

Note 2 to entry: The concept of data element type is represented in many publications by the term "property".

3.1.10
data specification
rules for describing items belonging to a particular class using entries from a concept dictionary and reference to a specific formal syntax

EXAMPLE An ISO TS 22745-30 compliant identification guide, ISO 13584-511 and ISO 8000-2 are data specifications.

[SOURCE: ISO TS 29002-4:2009, 3.5, modified – Example 1 has been modified, the reference to ISO 8000-102 has been updated and replaced by ISO 8000-2 and Example 2 has been removed.]

3.1.11
data supplier
organization that provides supplier libraries

EXAMPLE Data suppliers can be device manufacturers, machine manufacturers, vendors, distributors, system integrators, tool providers.

3.1.12
DF asset
digital representation of a PS asset and/or a role

3.1.13
DF asset class
description of a set of PS assets and/or roles that share common characteristics

3.1.14
DF asset class association
description of DF asset links which can be established between specific DF assets

3.1.15
DF asset link
digital representation of a relationship between two or more PS assets or between two or more roles

3.1.16
DF dictionary
concept dictionary owned by an enterprise and used for its Digital Factories and DF libraries

3.1.17
DF library
library owned by an enterprise and used for its Digital Factories

3.1.18
DF reference model
set of model elements for creating and managing a Digital Factory

3.1.19
Digital Factory
digital representation of a production system

Note 1 to entry: A Digital Factory can represent an existing or planned production system.

Note 2 to entry: The representation of a production system can include representation of PS assets and representation of roles.

3.1.20
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, 3.1.10]

3.1.21
library
identified set of library entries that is used to store and exchange product type information for creating and maintaining Digital Factories

3.1.22
library entry
identified content in a library

3.1.23
life cycle
evolution of a system, product, service, project or other human-made entity from conception through retirement

EXAMPLE Typical phases of a production system life cycle are conceptual development, planning, specification, design, engineering, construction, configuration, commissioning, operation, maintenance, decommissioning, and disposal.

[SOURCE: ISO/IEC/IEEE 15288:2015, 4.1.23, modified – The example has been added.]

3.1.24
production system
system intended for production of goods

Note 1 to entry: The concept of production system includes spare parts.

Note 2 to entry: The concept of production system does not encompass the whole manufacturing facility. It excludes in particular the supporting infrastructure (such as building, power distribution, lighting, ventilation). It also excludes financial assets, human resources, raw process materials, energy, work pieces in process, end products.

Note 3 to entry: Production systems can support different types of production processes (continuous, batch, and discrete).

3.1.25
production system asset
PS asset
asset that is a constituent of a production system

Note 1 to entry: A PS asset can be a part, a device, a machine, software, a control system or any collection of PS assets. It can have physical characteristics, for example mechanical, electrical, electronic. It also can be assigned to one or more role(s).

3.1.26
PS asset type
set of PS assets with common characteristics and features

3.1.27
role
intended purpose within the context of a production system

Note 1 to entry: A role typically is assigned to a PS asset.

3.1.28
supplier library
library that is used for exchange of product information

3.1.29
technical discipline
area of technical expertise

EXAMPLE Electrical wiring, pipe layout, automation and mechanic.

3.2 Abbreviated terms

For the purposes of this document, the following abbreviated terms apply.

CDEL	Collection of Data Elements
DER	Data Element Relationship
DF	Digital Factory (as qualifier)
ID	Identifier
IEC CDD	IEC Common Data Dictionary (see IEC 61360 (all parts))
LOP	List of Properties (see IEC 61987-10)
PLC	Programmable Logic Controller
PS	Production System (as qualifier)
RAI	Registration Authority Identifier (see ISO/IEC 6523)
VFD	Variable Frequency Drive

NOTE The abbreviated term DF is only used as a qualifier for model elements specified in this document. It is not understood as a replacement for the Digital Factory concept defined in 3.1.19.

4 Overview of the DF framework

4.1 General

The DF framework specifies the DF reference model and rules for using the DF reference model. The DF reference model is a set of model elements. The rules are used for creating and managing Digital Factories. The DF framework also defines rules for construction of libraries based on concept dictionaries.

The DF framework enables each enterprise to use and develop interoperable software tools and applications in order to support all activities within the life cycle of a production system. These activities access and update the information in the Digital Factory.

The DF framework relies upon referencing or integrating information (e.g. master data according to ISO 8000-2:2018), from several sources, such as:

- standardized dictionaries;
- consortium dictionaries;
- supplier dictionaries;
- supplier libraries.

A production system (in the real world) is composed of PS assets and is represented by a Digital Factory (in the virtual world). The Digital Factory is composed of DF assets. DF assets are representations of the PS assets. Relationships between PS assets are represented as DF asset links.

The DF asset contains the role-based equipment information and/or the physical asset information.

NOTE IEC 62264-2 describes the concepts of role-based equipment and physical asset.

The DF framework is illustrated in Figure 1. The arrows in the figure represent the flow of information. Rules are applied to managing the information flow.