IEC TS 62832-1

Edition 1.0 2016-12

TECHNICAL SPECIFICATION

colour inside

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

IEC TS 62832-1:2016-12(en)

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

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ICS 25.040.40

ISBN 978-2-8322-3691-8

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

Part 1: General principles

FOREWORD

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- the required support cannot be obtained for the publication of an International Standard, despite repeated efforts, or
- the subject is still under technical development or where, for any other reason, there is the future but no immediate possibility of an agreement on an International Standard.

Technical specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.

IEC TS 62832-1, which is a technical specification, has been prepared by IEC technical committee 65: Industrial-process measurement, control and automation.

This first edition cancels and replaces IEC TR 62794 published in 2012. This edition constitutes a technical revision.

This first edition includes the following significant changes with respect to IEC TR 62794:

- initial project was split into several parts to facilitate work progress;
- contents were completely reworked based on National Committee comments.

The text of this technical specification is based on the following documents:

Enquiry draft	Report on voting
65/629/DTS	65/649/RVC

Full information on the voting for the approval of this technical specification 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.

A bilingual version of this publication may be issued at a later date.

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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 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 production system, for example during the planning, development process, and operation. This situation spurs the enterprise to exchange product and production system data in electronic form.

However, each enterprise and each department inside the enterprise describes 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, cloud.

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

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 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) 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 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 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

While the standards mentioned above provide a method for describing properties of a given device, IEC 62832 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 provides a framework used 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 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 the IEC 62832 series

The IEC 62832 series consists of multiple parts which provide:

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

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

Part 1: General principles

1 Scope

This part of IEC 62832, which is a Technical Specification, 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 or discrete control) in any industrial sector (for example aeronautic industries, automotive, chemicals, wood).

NOTE 1 This document does not provide an application scenario for descriptions based on ISO 15926, because ISO 15926 uses a different methodology for describing production systems.

NOTE 2 In order to support oil and gas production systems, other methodologies for describing the assets can be used (for example based on ISO 22745 or ISO 13584-42).

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.

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

NOTE Relationships between definitions are shown in Annex A.

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

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

3.1.3
collection of data elements
CDEL
identified set of data elements

3.1.4
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.]

3.1.5
concept dictionary entry
description of a concept containing, at a minimum, an unambiguous concept identifier, a term, and a definition

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

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

3.1.7
data element relationship
relationship between data elements

3.1.8
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".

3.1.9
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.]

3.1.10
DF asset
digital representation of a production system asset

Note 1 to entry: A DF asset is uniquely identified either by a role identifier (for role-based equipment information) or a serial number (for physical asset information).

3.1.11
DF asset class
description of a set of DF assets that share common data element types

3.1.12
DF asset link
digital representation of a relationship between two or more PS assets

3.1.13
DF library
library owned by an enterprise for use in one or more Digital Factories

3.1.14
DF reference model
set of model elements for creating and managing a Digital Factory

3.1.15
Digital Factory
digital representation of a production system

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

3.1.16
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]

3.1.17
library
identified set of DF asset classes, DF asset class associations, data element relationships and view elements

3.1.18
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, 4.1.22, modified – The example has been added.]

3.1.19
master data
data held by an organization that describes the entities that are both independent and fundamental for that organization, and that it needs to reference in order to perform its transactions

[SOURCE: ISO 8000-2:2012, 11.1, modified – The three notes and the example have been removed.]

3.1.20
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, or discrete).

3.1.21
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 function, a control system or any collection of PS assets. It can have physical characteristics, for example mechanical, electrical, electronic, and/or role-based characteristics, for example function, information.

3.1.22
supplier library
library provided by a data supplier

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