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Digital twin – Concepts and terminology

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DIGITAL TWIN – CONCEPTS AND TERMINOLOGY

FOREWORD

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ISO/IEC 30173 has been prepared by subcommittee 41: Internet of Things and Digital Twin, of ISO/IEC joint technical committee 1: Information technology. It is an International Standard.

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

Draft	Report on voting
JTC1-SC41/362/FDIS	JTC1-SC41/372/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1, available at www.iec.ch/members_experts/refdocs and www.iso.org/directives.

IMPORTANT – The "colour inside" logo on the cover page of this document indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

Digital transformation continues to reshape the world at multiple scales, from a city to a building, a factory, an automobile, a process and so on. The concept of a digital twin (DTw) is not new. The concept of twinning in aerospace has been in use for over 50 years. Advances in digitalization, for example those related to the industrial Internet of Things, have enabled the concept to develop and spread outside of capital-intensive industries.

Digital twin has the potential to be widely used in multiple domains such as smart manufacturing, smart cities, smart agriculture, smart energy, smart buildings, smart health care, smart mining and many other fields. However, different fields have developed in isolation, leading to different concepts and terminology. The benefits that can be derived from the use of a digital twin will depend on the use case or cases that it has been conceived to satisfy. The degree to which the benefits are realized is dependent on the implementation of the digital twin and the degree to which it can be trusted to represent the behaviour of the target entity it represents. For example, it can help:

a) simulate and predict products or production lines, resulting in production cycle reduction and cost reduction for manufacturing companies;

b) optimize city construction based on simulation models, and realize visualization, convenience and intelligent city management for city planners;

c) monitor and optimize production operations, and perform predictive diagnosis on machinery and equipment for agricultural producers;

d) achieve visual monitoring management of energy production and transmission processes, as well as fault analysis and remote operation and maintenance for energy managers;

e) monitor patients' real-time conditions, provide personalized medical solutions, dynamically optimize medical resources for doctors, and so on.

The essence of digital twin is a pairing of two things:

– something that provides a functional purpose in reality, for example, an automobile or a petrochemical platform, designated as a target entity in this document;

– a representation of that target entity as a digital entity for the purpose of connection, integration, analysis, simulation, visualization, optimization, collaboration or, when necessary, providing external management for that target entity.

In view of the increased interest in and potential applications of the digital twin technologies, there is a need to establish a common basis and terminology to enable collaboration and cooperation, and to promote a common understanding of the concept.

The purpose of this document is to:

1) provide a common basis for understanding the concept and composition of a digital twin through definitions of digital twin-related concepts;

2) provide an overview of the life cycle of a digital twin in relation to the target entity it represents;

3) provide a basis for the development of standards, specifications and use of digital twins.

This document provides generic digital twin concepts and terminology that can be applied in any domain or across domains.

DIGITAL TWIN – CONCEPTS AND TERMINOLOGY

1 Scope

This document establishes terminology for digital twin (DTw) and describes concepts in the field of digital twin, including the terms and definitions of digital twin, concepts of digital twin (e.g. digital twin system context, life cycle process for digital twin, types of digital twin), functional view of digital twin, and digital twin stakeholders.

This document can be used in the development of other standards and in support of communications among diverse, interested parties or stakeholders.

This document is applicable to all types of organizations (e.g., commercial enterprises, government agencies, and not-for-profit organizations).

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:

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

3.1 General terms

3.1.1
digital twin
DTw
digital representation (3.1.8) of a *target entity* (3.1.3) with data connections that enable convergence between the physical and digital states at an appropriate rate of synchronization

Note 1 to entry: Digital twin has some or all of the capabilities of connection, integration, analysis, simulation, visualization, optimization, collaboration, etc.

Note 2 to entry: Digital twin can provide an integrated view throughout the life cycle of the target entity.

3.1.2
entity
<digital twin> thing (physical or non-physical) having a distinct existence

EXAMPLE Person, object, event, idea, process, etc.

[SOURCE: ISO/IEC 20924:2021, 3.1.18, modified – The example has been added.]

3.1.3
target entity
entity (3.1.2) providing a functional purpose in reality which is the subject of *digital representation* (3.1.8)

Note 1 to entry: The target entity, which provides some functional purpose in reality, can be either physical or digital under consideration.

3.1.4
physical entity
entity (3.1.2) in the physical world that can be the subject of sensing and/or actuating

[SOURCE: ISO/IEC 20924:2021, 3.1.27]

3.1.5
digital entity
computational entitiy comprising data elements and procedural elements

3.1.6
physical domain
classification of physical entities under consideration

3.1.7
digital domain
classification of digital entities under consideration

Note 1 to entry: Entities in the digital domain can be embedded in a physical domain.

3.1.8
digital representation
digital entity representing either a set of properties or behaviours or both of one or more observable elements

3.1.9
modelling
using symbolic paradigms or formal languages to create an abstract representation of a thing

3.1.10
ecosystem
infrastructure and services based on a network of organizations and stakeholders

Note 1 to entry: Organizations can include public bodies.

[SOURCE: ISO/IEC TS 27570:2021, 3.8]

3.1.11
life cycle
evolution of a system, product, service, project or other human-made entity from conception through retirement

[SOURCE: ISO/IEC/IEEE 15288:2023, 3.21]

3.1.12
semantics
rules that provide the intended meaning of entities or things to construct, deploy and use

3.1.13
semiotics
study of signs and their properties including the relationships between the domains of symbols, concepts and cyber-physical phenomena

3.1.14
control loop
<digital twin> feedback link between digital entities and target entities whereby the digital entity receives data from the *target entity* (3.1.3) and issues back to the target entity data that are used to modify the behaviour of the target entity

Note 1 to entry: Control loops use engineering control methods for the purpose of automation, e.g. to keep the temperature on an engine under control of a certain limit.

3.1.15
concept
<semiotics> semantic artifact that represents meaning of a symbol, a thing or a phenomenon

3.1.16
symbol
<semiotics> ontological artifact that denotes a certain meaning, a thing or a phenomenon

3.1.17
phenomenon
<semiotics> thing artifact that is symbolized by an ontological symbol and has implemented certain concepts

3.1.18
asset
entity (3.1.2) that has potential or actual value to an organization

[SOURCE: ISO 6707-4:2021, 3.1.2, modified- In the definition, "item, thing or" has been deleted.]

3.1.19
object
concept or a physical thing existing in the real world

[SOURCE: ISO 15531-31:2004 3.5.7, modified – In the definition, "which may" has been deleted.]

3.1.20
synchronization
<digital twin> action of making the states of target entity and digital entity synchronized, using network for real time system

3.1.21
digital twin system
system providing functionalities for the digital twin composed of inter-operating target entities, digital entities, data connections, and models, data and interfaces involved in the data connection process

3.2 Data-related terms

3.2.1
data
reinterpretable representation of information in a formalized manner suitable for communication, interpretation, or processing

[SOURCE: ISO/IEC 2382:2015, 2121272, modified – Notes have been deleted.]

3.2.2
asset data
facts, concepts or instructions pertaining to an *asset* (3.1.18)

3.2.3
big data
data set(s) with characteristics (e.g. volume, velocity, variety, variability, veracity, etc.) that for a particular problem domain at a given point in time cannot be efficiently processed using traditional technologies and techniques in order to extract value

Note 1 to entry: The term Big Data is commonly used in many different ways, for example as the name of the scalable technology used to handle big data extensive datasets.

[SOURCE: ISO/IEC 38505-1:2017, 3.2, modified – In the definition, "current/existing/established/" has been deleted.]

3.3 Model-related terms

3.3.1
statistics model
model that uses mathematical analysis tools to build a representation of the data for the purpose of conducting analysis to infer any relationships between variables or discover insights

3.3.2
engineering model

model that includes geometry, materials, components and behaviour relevant throughout the entity life cycle

3.3.3
information model
model of a set of facts, concepts or instructions to meet a specific requirement

[SOURCE: ISO 6707-2:2017, 3.2.35]

3.4 Performance-related terms

3.4.1
verification
confirmation, through the provision of objective evidence, that specified requirements have been fulfilled

[SOURCE: ISO 9000:2015, 3.8.12, modified – The notes to entry have been deleted.]

3.4.2
validation
confirmation, through the provision of objective evidence, that the requirements for a specific intended use or application have been fulfilled

[SOURCE: ISO 9000:2015, 3.8.13, modified – The notes to entry have been deleted.]