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Smart manufacturing — Reference architecture model industry 4.0 (RAMI4.0)

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National foreword

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SMART MANUFACTURING – REFERENCE ARCHITECTURE MODEL INDUSTRY 4.0 (RAMI4.0)

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IEC PAS 63088 has been processed by IEC technical committee 65: Industrial-process measurement, control and automation.

The text of this PAS is based on the following document:	This PAS was approved for publication by the P-members of the committee concerned as indicated in the following document
Draft PAS	**Report on voting**
65/645/PAS	65/655/RVDPAS

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This PAS shall remain valid for an initial maximum period of 3 years starting from the publication date. The validity may be extended for a single period up to a maximum of 3 years, at the end of which it shall be published as another type of normative document, or shall be withdrawn.

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

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INTRODUCTION

Background

Industry requires constant attention on optimization, cost efficiency, energy efficiency, environmental concerns, quality, security, safety, time-to-market, inventory reduction, simulation, ease of maintenance, etc. Customers also want to satisfy new requirements and address new use cases now reachable given the availability of new technologies. Addressing these challenges, several projects in different countries were issued with similar names and aims, e.g. in Germany “Industrie 4.0”, in France “Industrie du Futur”, in China “Intelligent Manufacturing”, in Japan etc.

Manufacturers, customers, service providers are working in a more and more global market. The need of interoperability of products, open interfaces, etc. can only be achieved with International Standards. To cover these needs, IEC and ISO have activities related to Smart Manufacturing.

Objective

This specification defines a Reference Architecture Model to identify, structure, and illustrate the different areas where standards exist or standards are required. It allows setting standards in relation to different aspects, hierarchies and life cycles.

Life cycles are relevant to products, to assets in the factory or plant, to orders from planning to cash and to the supply chain covering the process from source to delivery.

In addition, this specification defines term and definitions generally for Smart Manufacturing. As Smart Manufacturing is covering different domains (batch, continuous, discrete, etc.), terms need to be harmonized and globally accepted.

The fundamental purpose of Industry 4.0 is to facilitate cooperation and collaboration between technical objects, which means they have to be virtually represented and connected. In this context, a technical object is an object that is of value to an organization, which therefore not only means physically tangible objects, but also intangible objects such as ideas, archives and software. The concept of Industry 4.0 is intended to create digital description rules for a technical object throughout its entire lifetime, and for the associated changes in value, in the form of the Reference Architecture Model for Industry 4.0 “RAMI4.0”. The purpose of this model is to represent the technical object and all aspects relevant to it, from its development, production and use right through to its disposal. The Industry 4.0 component provides a digital description of the object, making it possible to represent that object virtually.

Technical objects are intentionally manufactured in order to fulfil a specific purpose. They possess common characteristics in terms of their lifetime and the associated changes in value. Technical objects for which a “change in value” or an “owner” are important aspects are also referred to as “technical assets”. Because this is almost always the case, the terms “technical object” and “technical asset” can be regarded as synonymous. In this document, the term “technical asset”, or simply “asset” is used.

This document describes two fundamental reference models for the Industry 4.0 concept:

– The reference architecture model RAMI4.0 is a reference model of Industry 4.0 reference architecture and gives a structured description of fundamental ideas. See Clause 5.
– The I4.0 component reference model provides digital access to this description. See Clause 6.

The central concept of Industry 4.0 is that assets can be combined in any way, and these assets are formally described in sufficient detail for use in the digital world. This methodology not only enables sufficient generic descriptions of a configuration, but through an increasing degree of detail also allows for very specific descriptions. This is a core concept regardless of the way in which the asset is used.

To virtually represent configurations of assets and the connections between them, the “principle of recursive description of assets” is used to characterize an asset as follows:

– the structural description is compliant with RAMI4.0;
– a configuration of two or more assets collectively forms a new asset, which is described using RAMI4.0;
– components of an asset can themselves represent separate assets that are described with RAMI4.0;
– the asset description is provided as structured information in the administration shell of the I4.0 component that acts as a virtual representation of an asset.

This means that any configuration can be digitally represented to any degree of granularity by describing structured assets, and combinations thereof, using RAMI4.0.

SMART MANUFACTURING – REFERENCE ARCHITECTURE MODEL INDUSTRY 4.0 (RAMI4.0)

1 Scope

This document, which is a PAS, describes a reference architecture model in the form of a cubic layer model, which shows technical objects (assets) in the form of layers, and allows them to be described, tracked over their entire lifetime (or “vita”) and assigned to technical and/or organizational hierarchies.

It also describes the structure and function of Industry 4.0 components as essential parts of the virtual representation of assets.

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 61360-1, *Standard data element types with associated classification scheme for electric components – Part 1: Definitions – Principles and methods*

IEC 61360-2, *Standard data element types with associated classification scheme for electric components – Part 2: EXPRESS dictionary schema*

IEC TR 62794[1], *Industrial-process measurement, control and automation – Reference model for representation of production facilities (digital factory)*

IEC TS 62832-1, *Industrial-process measurement, control and automation – Digital factory framework – Part 1: General principles*

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
administration shell
virtual digital and active representation of an I4.0 component in the I4.0 system

Note 1 to entry: An administration shell contains the manifest and the component manager.

[1] Withdrawn.