
**Automation systems and
integration — Assessment on
convergence of informatization
and industrialization for industrial
enterprises —**

**Part 1:
Framework and reference model**

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*Systèmes d'automatisation et d'intégration — Évaluation de la
convergence de l'informatisation et de l'industrialisation pour les
entreprises industrielles —*

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Partie 1: Cadre et modèle de référence



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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).

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This document was prepared by Technical Committee ISO/TC 184, *Automation systems and integration*, Subcommittee SC 5, *Interoperability, integration, and architectures for enterprise systems and automation applications*.

A list of all parts in the ISO 22549 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

Convergence of informatization and industrialization (CII) refers to a process that integrates information technology into industrial production. The purpose of convergence is to improve productivity and resource allocation by digital transformation.

This improvement consists of:

- increasing the integration of production and resource allocation (internally and with each other);
- making production and resource allocation more dynamic and responsive to external changes;
- optimizing production and resource allocation.

The purposes of this document include is to provide industrial enterprises guidance for:

- assessing the current situation of CII;
- finding weakness within the CII;
- identifying ways to improve CII.

The intended users of this document can be grouped into the following categories:

- independent third-party, e.g. a consulting company or government department, that assesses the maturity of CII;
- organization in charge of production management department, quality management department, inventory management department, etc., which sponsors an assessment of itself or a subordinate organization;
- any other enterprises who have interest in digital transformation.

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Automation systems and integration — Assessment on convergence of informatization and industrialization for industrial enterprises —

Part 1: Framework and reference model

1 Scope

This document defines the basic principles for an assessment concerning the convergence of informatization and industrialization (CII) in industrial enterprises, including the following:

- assessment framework definitions;
- assessment reference model definitions;
- assessment reference model components.

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:

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

3.1

industrialization

procedure of increasing productivity using sequential task allocation to automated or semi-automated methods, or to individuals

3.2

informatization

procedure of generating information from data within a given context using computing and communication technologies

3.3

convergence of informatization and industrialization

CII

integrating information technology into industrial production, which promotes the development of industry towards a higher value-added direction through wide application of information and restructuring of traditional industry

3.4

domain application

application of information technology in a single business activity that has a well-defined and identifiable boundary of responsibility and authority for subordinate activities

3.5

Level 4

level containing functions involved in the business-related activities needed to manage a manufacturing organization

Note 1 to entry: See [Annex B](#).

[SOURCE: IEC 62264-1:2013, 3.1.16, modified — “level containing” has been added before functions.]

3.6

Level 3

level containing functions involved in managing the workflows to produce the desired end-products

Note 1 to entry: See [Annex B](#).

[SOURCE: IEC 62264-1:2013, 3.1.17, modified — “level containing” has been added before functions.]

3.7

Level 2

level containing functions involved in monitoring and controlling of the physical process

Note 1 to entry: See [Annex B](#).

[SOURCE: IEC 62264-1:2013, 3.1.17, modified — “level containing” has been added before functions.]

3.8

business activity

partially ordered set of enterprise activities on Level 3 and Level 4 of functional hierarchy defined in IEC 62264

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3.9

comprehensive integration

process of linking together functional applications within an enterprise

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3.10

collaborative integration

process of linking together functional applications between different enterprises

3.11

reference model

abstract framework or domain-specific ontology consisting of an interlinked set of clearly defined concepts produced by an expert or body of experts in order to encourage clear communication

Note 1 to entry: A reference model can represent the component parts of any consistent idea, from business functions to system components, as long as it represents a complete set. This frame of reference can then be used to communicate ideas clearly among members of the same community.

3.12

assessment objective

statement, provided as part of the assessment input, which defines the reasons for performing the assessment

[SOURCE: ISO/IEC 33001:2015, 3.2.6]

3.13

assessment expert team

group of one or more professional individuals who jointly perform an assessment process

[SOURCE: ISO/IEC 33001:2015, 3.2.10, modified — the word “professional” has been added before individuals.]

3.14 assessment framework

schema for use in characterizing an industrial enterprise quality characteristic of an implemented industrial enterprise

4 Abbreviated terms

- CII convergence of informatization and industrialization
- OPM object-process methodology

5 Overview of assessment

5.1 General

The assessed objects of a CII assessment include enterprise manufacturing activities, enterprise business activities and enterprise infrastructure. Manufacturing activities are associated with manufacturing operations management. Enterprise business activities are associated with activities on Level 3 and Level 4 of functional hierarchy. Enterprise infrastructure is associated with capital investment, equipment and facilities etc.

For assessment of CII, data shall be acquired from Level 2, Level 3 and Level 4 to answer questionnaires. [Annex B](#) provides further information for each Level in detail. However, this document covers enterprise activities beyond Level 4 that support the enterprise but are not directly related to manufacturing and are therefore not addressed by the IEC 62264 functional hierarchy.

5.2 Enterprise assessing system ISO 22549-1:2020

[Figure 1](#) depicts the architecture of the enterprise assessing system and describes the relationship of enterprise assessing process with its input and output objects which combine into extent of CII using the aggregating process.

NOTE The figures in this document use the graphical notation of object-process methodology, as defined in ISO/PAS 19450. See [Annex A](#).

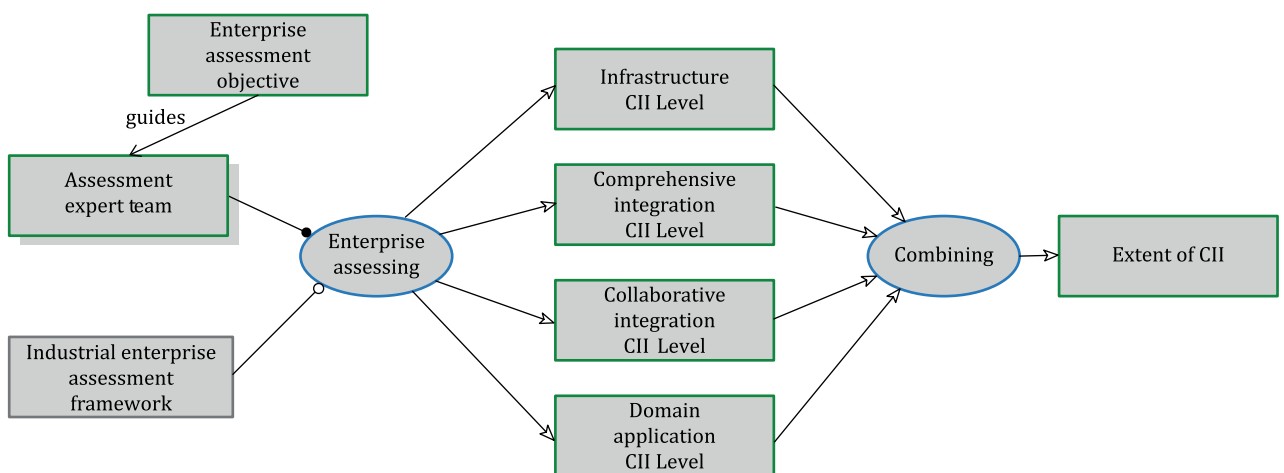


Figure 1 — Enterprise assessing system

Assessment expert team enables enterprise assessing, which requires industrial enterprise assessment framework.

Enterprise assessment objective guides assessment expert team.

Enterprise assessment objective includes:

- a) assessment of the current situation of CII,
- b) identification of weakness within the CII,
- c) identification of ways to improve CII.

The extent of CII shall be assessed in terms of infrastructure, domain application, comprehensive integration and collaborative integration within that enterprise by the enterprise assessing process. Enterprise assessing process results are the infrastructure CII level, domain application CII level, comprehensive integration CII level and collaborative integration CII level which combine into extent of CII.

5.3 Industrial enterprise assessment framework

The industrial enterprise assessment framework consists of evaluation questionnaires, maturity model, and assessment reference model. Assessment reference model supports evaluation questionnaires and maturity model, as shown in Figure 2.

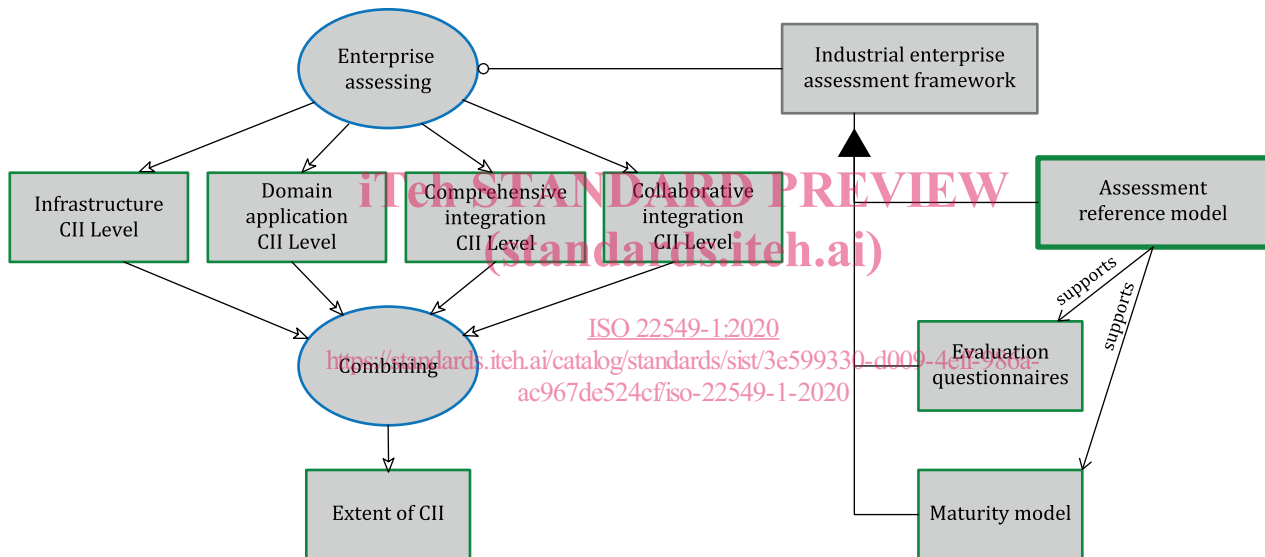


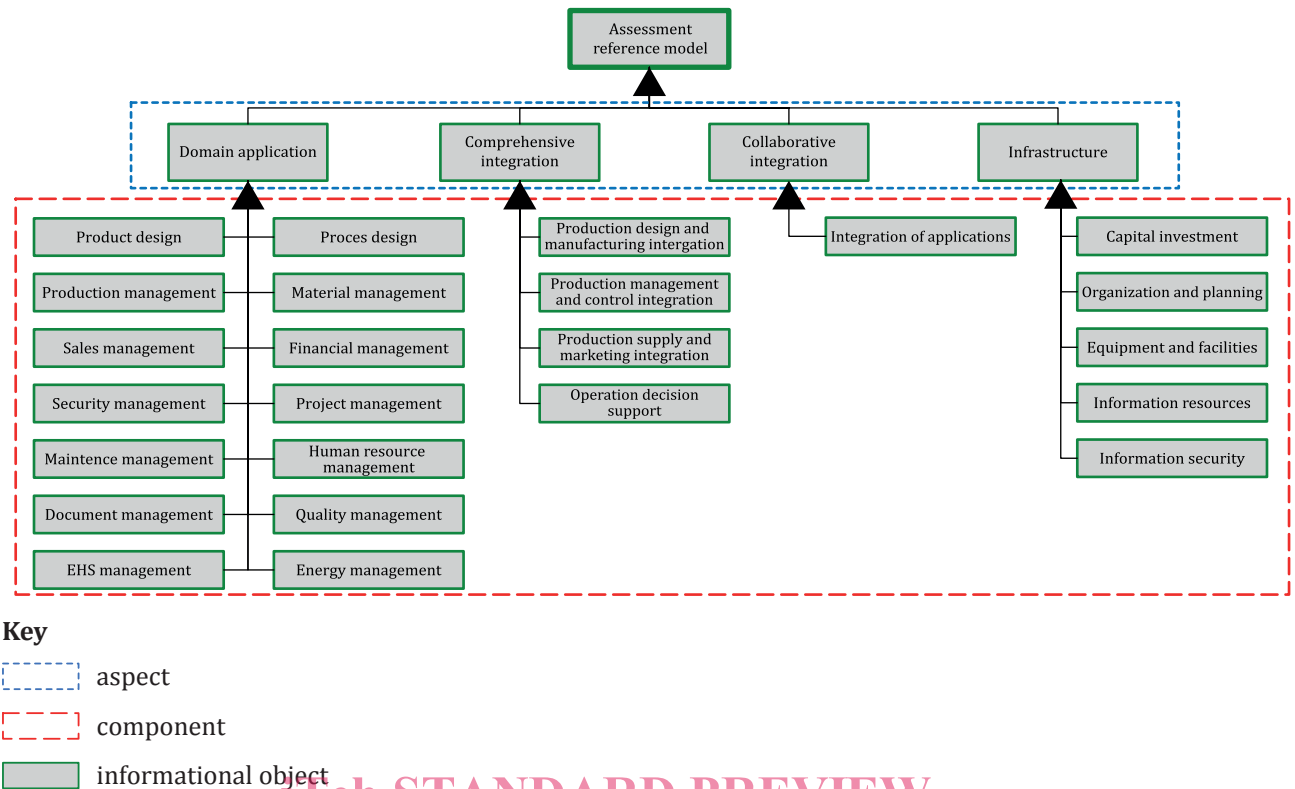
Figure 2 — Industrial enterprise assessment framework

6 Assessment reference model definitions

Figure 3 presents the structure of assessment reference model. The enterprise assessing process shall refer to the following aspects:

- infrastructure;
- domain application;
- comprehensive integration;
- collaborative integration.

Four aspects are grouped by short-dashes (blue) line and twenty-four subordinate components to four aspects are grouped by long-dashes (red) line.



Key

 aspect

 component

 informational object

Figure 3 — Assessment reference model (aspect and its subordinate component)

Infrastructure consists of capital investment, organization and planning, equipment and facilities, information resources, and information security.

The assessment of infrastructure shall consider the construction of the infrastructure and conditions related to CII.

Domain application consists of product design, process design, production management, materials management, sales management, financial management, security management, project management, maintenance management, human resource management, document management, quality management, environment, health and safety management, and energy management.

The assessment of domain application shall consider the application of information technology in a single business activity that has a well-defined and identifiable boundary of responsibility and authority for subordinate activities.

Comprehensive integration consists of product design and manufacturing integration, production management and control integration, production supply and marketing integration, and operation decision support.

The assessment of comprehensive integration shall consider the process of linking together functional applications within an enterprise.

The assessment of collaborative integration shall consider the process of linking together functional applications between different enterprises.