
**Automation systems and
integration — The Big Picture of
standards**

*Systèmes d'automatisation et intégration — Panorama des
documents normatifs*

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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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 184, *Automation systems and integration*.

Introduction

The main objective of the Big Picture is to clarify the landscape of standards and standardization projects in smart manufacturing (covering all sectors of activity, all value chains, and all types of control: discrete, batch and continuous) by using clearly defined criteria of analysis (object of standardization, type of standard, industrial sector, life cycle, value chain, role level, etc.).

The IEC Sector Board 3 (SB3) activity began around 1997 and had members consisting of executives and technical managers from selected industrial sectors. The SB3 was assisted by a technical steering group of representatives from ISO/TC 184, IEC/TC 65 and other technical committees developing international standards for these industrial sectors. The SB3 efforts and deliverables (e.g. ISO/IEC Guide 75) focused on establishing the rationale, direction and strategic actions to assist both industry and the standards development organizations in assessing the market relevance of proposed standardization projects. The “Big Picture” project delivered necessary tools in realizing the SB3 objectives.

The first utilization of the term “Big Picture” by ISO/TC 184 was made by ISO/TC 184/SC 4/IMTF (Integrated Manufacturing Task Force) in its report to ISO/TC 184/SC 4 in 2001. This report was limited to the identification of the place and role of the various standards developed within TC 184/SC 4 and to their relationship. The main interests of this report were the first attempt for an overall representation of the ISO/TC 184/SC 4 area of work using a graphical representation on which each concerned standard or project of standardization can be placed as well as the methodology to obtain this representation.

This work was preceded by other work done in 1999 and 2000 by TC 184/SC 4/JWG 8, on the request of the Chairman of ISO/TC 184/SC 4, on “manufacturing related standards”. Nevertheless, this work includes preliminary considerations on redundancy, on the impact of the point of view used in each standard. It also includes a preliminary list of ISO/TC 184 and non ISO/TC 184 standards related to manufacturing as well as a first analysis of the relationships between features that can have the same naming in different standards but address concepts that are in fact different.

Later on, ISO/TC 184 set up a task force led by its Advisory Group and named “BSAD”, which was appointed to list the various areas of interest (universe of discourse) for ISO/TC 184 and its subcommittees. The objectives of this work was again to try to identify the place of existing standards and possible areas of work in the ISO/TC 184 “universe of discourse”, using a distinction between developments that are in the core of the scope of ISO/TC 184, areas that are impacted by ISO/TC 184 work and/or are likely to impact ISO/TC 184 developments, and areas that are just to be monitored according to the fact that they are in the “universe of discourse” of ISO/TC 184 without any other relationship with its work.

These activities were followed by the first attempts to carry the “Big Picture” effort to ISO/TC 184/SC 5 and finally at the ISO/TC 184 level (Louisville meeting between SC 4 and SC 5).

A common activity between ISO/TC 184 and IEC/TC 65 started in July 2008 by a meeting between Chairmen and continued with Joint Advisory Group meetings in 2009, in Frankfurt and Paris.

In 2010, a draft technical report was prepared.

In 2011, a renewed matrix and its user manual were circulated in ISO/TC 184 and IEC/TC 65. These documents were reviewed in the Joint Advisory Group meeting in 2011 (Berlin).

The ISO/TC 184 and IEC/TC 65 reference framework for the Big Picture was circulated at the end of 2011. Both ISO/TC 184 and IEC/TC 65 and their subcommittees populated the Big Picture Matrix on this reference framework.

This document is an update of the Big Picture reference framework circulated internally in ISO/TC 184 and IEC/TC 65 in 2011.

In 2012 and 2013, the French National Committee (AFNOR) continued refining the concepts.

In 2014 and 2015, EDF (Électricité de France) conducted a project for the exploiting of the Big Picture data in a smarter way. The project involved two academic institutions: Centre Universitaire d'Informatique (Geneva) and Centrale Lille\IG2I. The aim was to provide a “smart” access to

information on standardization and standards in order to facilitate their development and promote their interoperability, and to develop and present the methodology for access to normative information (see Annex A).

At the ISO/TC 184 plenary meeting in Nara, the results of the EDF project were demonstrated and Resolution 563 was endorsed: “TC 184 welcomes the EDF initiative to exploit and present the Big Picture, invites projects such as OGI to provide additional use cases and invites its Secretariat to pursue the creation of an ISO project under the TMB to further develop the tool. It is suggested that if the tool enters general use, consideration should be given to extending the ISO NP form to include the identification of categories of use.”

Figure 1 shows a summary of the Big Picture project history.

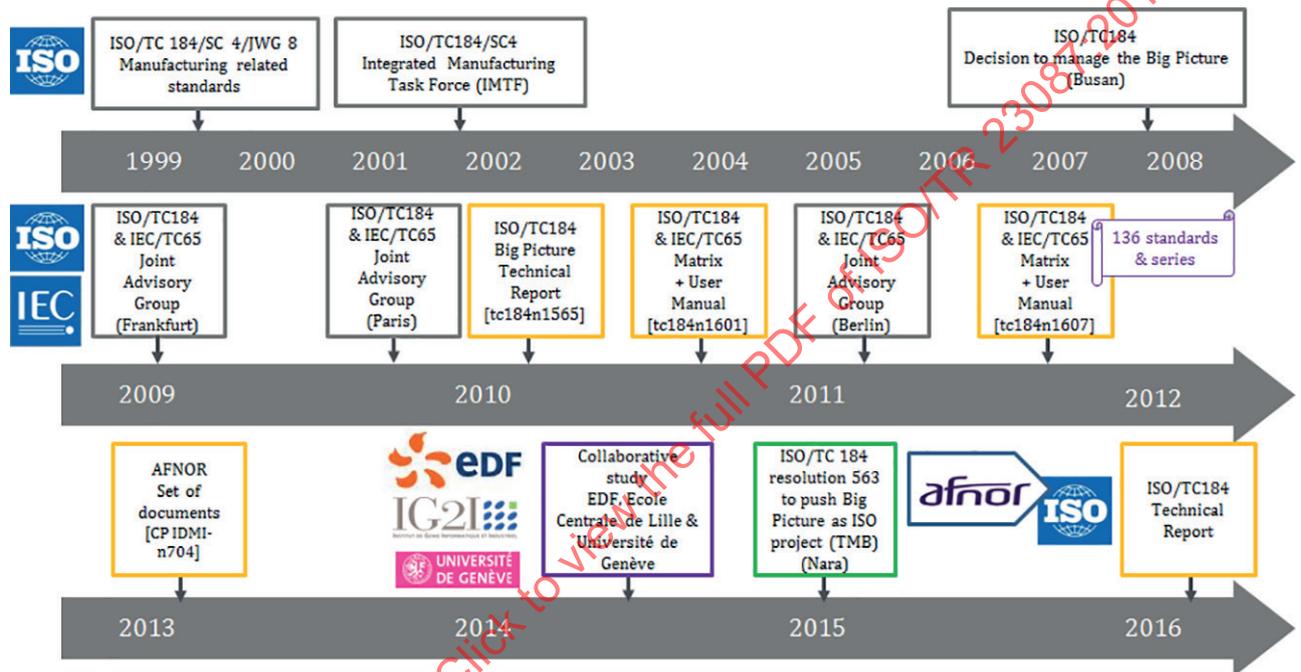


Figure 1 — History of the Big Picture project

This Technical Report may be used in the context of the common ISO-IEC project of international reference model for smart manufacturing.

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Automation systems and integration — The Big Picture of standards

1 Scope

This document is the reference framework for the Big Picture project.

The Big Picture aims at monitoring the consistency of published standards and current or future standardization projects.

The Big Picture enables the standardization stakeholders to identify, for each concerned standard or standardization project, the relevant characteristics related to the positioning and impact of the standard or standardization project in the industry.

Although the Big Picture was designed initially for the universe of discourse of ISO/TC 184 and then IEC/TC 65, it applies to manufacturing in general.

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 <https://www.iso.org/obp>

3.1

generalization

act of removing or modifying detail from a specific concept to produce a more general extent, use or purpose of this concept or the concept resulting from this operation

Note 1 to entry: Generalization is the inverse of *specialization* (3.9).

[SOURCE: ISO 19439:2006, 3.34, modified — the order has been changed]

3.2

generic

property of being a *generalization* (3.1) from a number of distinguishable entities based on their shared characteristics

[SOURCE: ISO 19439:2006, 3.35]

3.3

genericity

extent to which a concept or an object is *generic* (3.2)

[SOURCE: ISO 19439:2006, 3.37, modified— “or an object” has been added]

3.4

life cycle

set of distinguishable phases and steps within phases which an entity goes through from its creation until it ceases to exist

[SOURCE: ISO 19439:2006, 3.42]

3.5

model

abstract description of reality in any form (including mathematical, physical, symbolic, graphical or descriptive) that presents a certain aspect of that reality

[SOURCE: ISO 19439:2006, 3.47, modified — Note 1 to entry has been deleted]

3.6

point of view

aspect

specific set of properties addressed by a standard or project of standardization according to specific stakeholder concerns

EXAMPLE The point of view of a manufacturer, a user or a supplier.

Note 1 to entry: This concept is the application to standards of the concept of modeller views developed in ISO 15704, ISO 14258 and ISO 19439.

3.7

product

thing or substance produced by a natural or artificial process

[SOURCE: ISO 10303-1:1994, 3.2.26]

3.8

resource

enterprise entity that provides some or all of the capabilities required by the execution of an enterprise activity and/or business process

[SOURCE: ISO 15704:2000, 3.18]

3.9

specialization

general concept modified for a more limited extent, specific use or purpose, or the act of adding or modifying details to a general concept to produce a specialization thereof

Note 1 to entry: Specialization is the inverse of *generalization*(3.1).

[SOURCE: ISO 19439:2006, 3.62]

3.10

system

collection of real-world items organized for a given purpose

[SOURCE: ISO 15704:2000, 3.20, modified — Note 1 to entry has been deleted]

3.11

universe of discourse

collection of concrete or abstract things that belong to an area of the real world, selected according to its interest for the scope of the concerned standardization committees

[SOURCE: ISO 15531-1:2004, 3.6.50, modified — “the system to be modelled and for its corresponding environment” has been replaced with “scope of the concerned standardization committees” and Note 1 to entry has been deleted]

4 Objectives of the Big Picture

4.1 General

The objectives of the Big Picture are the improvement and the facilitation of systems, components, products and applications integration along the different life cycles. They can be split into three areas:

- identifying the place and role of the relevant standards and projects of standardization of ISO/TC 184 and IEC/TC 65;
- providing an outreach tool to other standardization committees; and
- promoting and explaining standardization efforts to industry managers and users of standards.

4.2 Identification of place and role of the concerned standards and projects of standardization in ISO/TC 184 and IEC/TC 65

Identifying the place and role of existing standards and projects of standardization in the universe of discourse of both ISO/TC 184 and IEC/TC 65 is necessary in order to enable standardization stakeholders to identify any need for new standards, to monitor possible overlaps and to clarify their roles and relationships in the field of automation systems and integration concerning:

- collaborative manufacturing throughout the life cycles of products, enterprises, supply chains;
- the application of multiple technologies, techniques and tools to manage and control the flow of information, materials and other resources within an extended enterprise or supply chain.

4.3 An outreach tool to other standardization committees

The Big Picture is designed to help and facilitate:

- cooperation and collaboration to reduce conflicts in work items;
- promoting the use of related deliverables and their benefits.

4.4 Promotion and explanation of standardization efforts to industry managers and users of standards

The promotion and explanation of standardization efforts specially address:

- the industry managers and standards users;
- the explanation of the place and role of each standard in the automation and integration process in manufacturing;
- highlighting the benefits of the use of concerned standards.

5 Conceptual background

Systems theories support explicitly or implicitly most of the standards developed in the universe of discourse of ISO/TC 184 (especially those developed by ISO/TC 184/SC 5 and ISO/TC 184/SC 4) as well as some of the standards developed by IEC/TC 65. Accordingly, any process or automation application may be described systematically as depicted in Figure 2 adapted from ISO 15531-31:2004, Annex D.

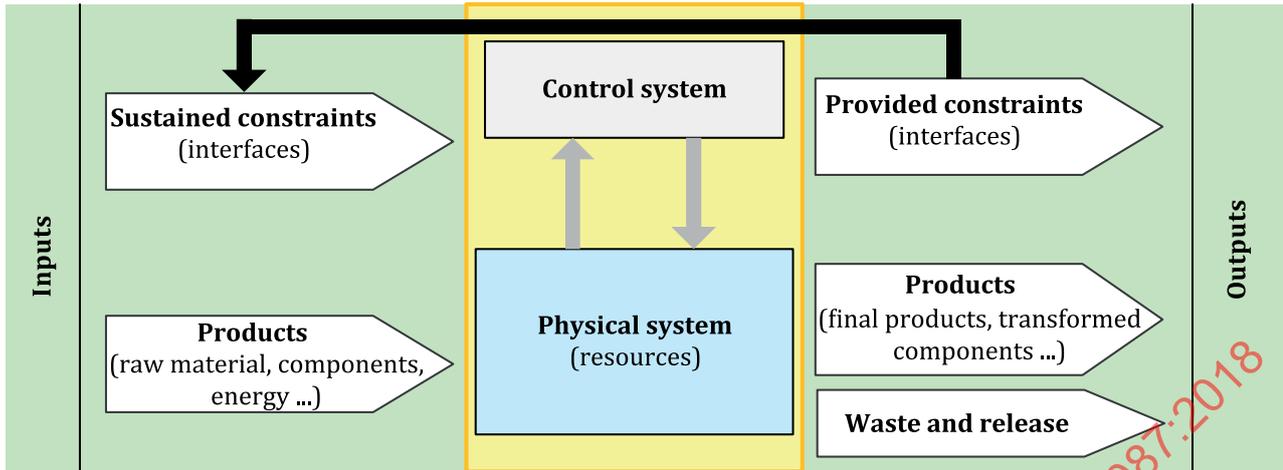


Figure 2 — Production or manufacturing system

Any system, including the control system and the physical system, may be divided in subsystems that will be described in the same way. Systems address applications and processes including software and hardware components (subsystems).

Products may include raw material, intermediate components and final products.

The physical system has resources (humans, machines, facilities...) that contribute to the transformation of inputs (product such as raw materials, components...) into others products (final products, transformed components). Some resources may be considered as products in other systems.

EXAMPLE A drill is a resource in a system which drills a hole such as a drilling machine. The same one is a product in a system which sharpens it such as a sharpening tool.

The control system is the part of the system that treats information coming from the physical system and from the environment (e.g. other systems), such as sustained constraints to monitor the physical system and submit needed information to the environment (e.g. others systems) such as provided constraints. It manages the interfaces with the environment and especially with the other concerned systems.

6 Big Picture diagram

6.1 Graphical representation

This graphical representation is a three-axis diagram, where the three axes are:

- the role level axis;
- the value chain axis;
- the life cycle axis.

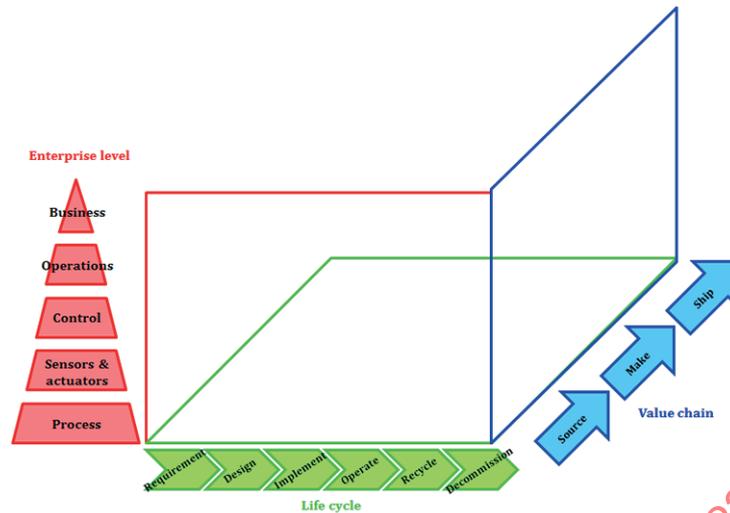


Figure 3 — Big Picture diagram

The target of this graphical representation (See [Figure 3](#)) is to identify in a clear, simple and educational way the place of the standard or standardization project in the universe of discourse of manufacturing automation and integration.

For example, [Figure 4](#) shows “control and make” standards.

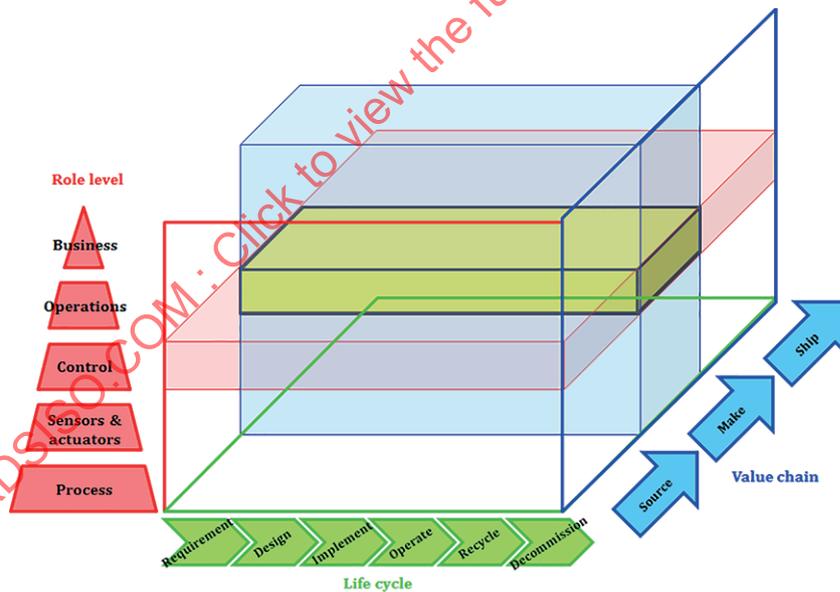


Figure 4 — Example: control and make

For example, [Figure 5](#) shows “business, operate and ship” standards.

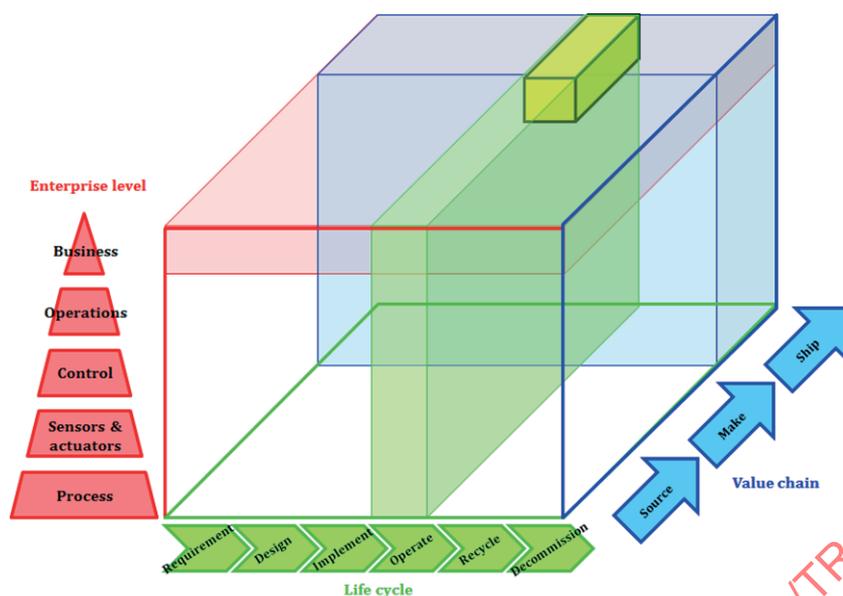


Figure 5 — Example: business, operate and ship

6.2 Role level

6.2.1 Short description

The axis “Role level” refers to the role-based hierarchy of an enterprise to which the standard is applicable. Some standards may serve more than one role.

6.2.2 Possible values

[Table 1](#) describes the possible values of “Role level”.

Table 1 — Role level

Possible values	Explanation	Source documents
Business	Business planning, operation and logistics Level 4 functions involved in the business-related activities needed to manage a manufacturing organization Establishing the basic plant schedule for production, material use, delivery, shipping, determining inventory levels, operational management, etc.	IEC 62264-1:2013, 3.1.16 IEC 62264-1:2013, 5.2.1
Operations	Operations management manufacturing operations management MOM activities within Level 3 of a manufacturing facility that coordinate the personnel, equipment and material in manufacturing Level 3 Functions involved in the business-related activities needed to manage a manufacturing organization Work flow/recipe control to produce the desired end products. Maintaining records and optimizing the production process, dispatching production, detailed production scheduling, reliability assurance, etc.	IEC 62264-1:2013, 3.1.22 IEC 62264-1:2013, 3.1.17 IEC 62264-1:2013, 5.2.1
Control	Level 2 functions involved in monitoring and controlling of the physical process Monitoring, supervisory control and automated control of the production process	IEC 62264-1:2013, 5.2.1
Sensors and actuators	Level 1 functions involved in sensing and manipulating the physical process	IEC 62264-1:2013, 3.1.18
Production process	Level 0 actual physical process	IEC 62264-1:2013, 3.1.19
Enterprise	Whole enterprise Enterprise one or more organizations sharing a definite mission, goals and objectives which provides an output such as a product or service	IEC 62264-1:2013, 3.1.10
Other	All out of making. For example when the object of standardization is a product.	

6.3 Value chain

6.3.1 Short description

The axis “Value chain” positions the standard on the chain of manufacturing from the supply operation to the sales and customer support operations.

[SOURCE: SCOR®¹]

6.3.2 Possible values

[Table 2](#) describes the possible values of “Value chain”.

Table 2 — Possible values of “Value chain”

Possible values	Explanation
Source	Buy side, supply chain management.
Make	Asset management. Includes resources, facility and asset management.
Ship	Sell side. For example, customer support management.
Whole	Source, make and ship.

6.3.3 Comments

From SCC website:

“SCOR® is typically used to identify, measure, reorganize and improve supply chain processes. This is accomplished by a cyclic process of:

Capturing the configuration of a supply chain. A supply chain configuration is driven by:

- plan levels of aggregation and information sources;
- source locations and products;
- make production sites and methods;
- deliver channels, inventory deployment and products;
- return locations and methods.

...”

6.4 Life cycle

6.4.1 Short description

The axis “Life cycle” defines the phase(s) of the life cycle covered by the standard.

6.4.2 Possible values

[Table 3](#) describes the possible values of “Life cycle”.

1) SCOR® (Supply Chain Operation Reference) is the trademark of a model from SCC (Supply Chain Council). This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of the product named.

Table 3 — Possible values of “Life cycle”

Possible values	Explanation
Requirements	“Requirements” also covers identification and concept according to ISO 15704.
Design	“Design” is synonymous with development and includes preliminary design and detailed design.
Implementation	“Implementation” includes construction and commissioning.
Operation	“Operation” includes production and maintenance.
Recycling/reuse	
Decommission	“Decommission” includes final disposal and waste treatment.
Whole	If the standard covers the whole life cycle.

6.4.3 Comments

The phases listed typically cover the life cycle production system but can be also used for other types of objects.

Three different life cycles are typically considered with the corresponding phases listed in [Table 4](#):

- product instance life cycle: consecutive and interlinked stages of a product system, from raw material acquisition or generation from natural resources to final disposal (see ISO 14040:2006, 3.1);
- product type life cycle: set of stages of a product type from the start of the development phase to the end of the product abandonment;
- production system life cycle: finite set of generic phases and steps a system may go through over its entire life history (see ISO 15704:2000, 3.11).

Table 4 — Alternative values of “Life cycle”

Possible values	Explanation
Applicable for all:	
Whole life cycle	If the standard covers the whole life cycle.
Applicable for systems:	
Requirements	“Requirements” also covers identification and concept according to ISO 15704.
Design	“Design” is synonymous with development and includes preliminary design and detailed design.
Implementation	“Implementation” includes construction and commissioning.
Operation	“Operation” includes production and maintenance.
Recycling/reuse	
Decommission	“Decommission” includes final disposal and waste treatment.
Applicable for product types:	
Requirements	
Design	“Design” is synonymous with development and includes preliminary design and detailed design.
Implementation	
Sales	
After sales support	
Applicable for product instances:	
Raw material acquisition	
Production	
Use	
Recycling/reuse	
Decommission	“Decommission” includes final disposal and waste treatment.

7 Big Picture matrix and facets

7.1 General

The Big Picture matrix is a spreadsheet where relevant standards and standardization projects can be described according to the Big Picture axis and additional attributes called facets.

The identification attributes of the standards and standardization projects are:

- standard body;
- standard series number;
- standard part number;
- standard title.

The facets are:

- object of standardization;
- type of standard;
- sector;
- interoperability approach;
- interoperability barrier;

- interoperability concern;
- conformity;
- point of view;
- genericity;
- explicit relationship;
- committee interest.

These facets are described in the following subclauses.

7.2 Example of matrix

Figure 6 and Annex B show examples of populated Big Picture matrices.

Standard	Object of standardization	Type of standard	Life cycle	Value chain	Role level	Sector
IEC/ISO 62264-1 Enterprise control	Interface	Overview	Whole	Whole	Operations	Any
IEC/ISO 62264-2 Object model attribute	Interface	Model	Whole	Whole	Operations	Any
IEC/ISO 62264-3 Activity models of manufacturing operations management	Interface	Model	Whole	Whole	Operations	Any
IEC/ISO 62264-5 Business to manufacturing transactions	Interface	Model	Whole	Whole	Operations	Any
IEC 62264- Enterprise-Control System Integration Joint ISO & IEC Logo	Model	Model	Whole	Whole	Business	Any
IEC 61917-10 Lists of Properties (LOPs) for Industrial-Process Measurement and Control for Electronic Data Exchange, Fundamentals	Product	Overview	Whole	Whole	Whole	Industrial automation
IEC 61917-11 List of Properties (LOP) for Measuring Equipment for electronic data exchange — Generic structures	Product	Model	Whole	Whole	Whole	Industrial automation

Figure 6 — Example of Big Picture matrix

7.3 Object of standardization

7.3.1 Short description

The facet “Object of standardisation” defines the focus in the system approach.

The standard specifies requirements/provisions that need to be provided/addressed/satisfied by “Object of standardisation”.

7.3.2 Possible values

Table 5 describes the possible values of “Object of standardization”.

Table 5 — Possible values of “Object of standardization”

Possible values	Explanation	Source documents
System	<p>— Definitions</p> <p>something of interest as a whole or as comprised of parts</p> <p>Therefore a system may be referred to as an entity. A component of a system may itself be a system, in which case it may be called a subsystem.</p> <p>collection of real-world items organized for a given purpose</p> <p>NOTE A system is characterized by its structure and its behaviour.</p> <p>— Examples of item</p> <p>Enterprise, factory, machine.</p>	<p>ISO/IEC 10746-2:2009, 6.5</p> <p>ISO 15745-1:2003, 3.32</p> <p>ISO 15704:2000, 3.20</p>
Device	<p>— Definition</p> <p>entity that performs control, actuating and/or sensing functions and interfaces to other such entities within an automation system</p> <p>— Comment</p> <p>The device is a resource for the manufacturing system.</p> <p>— Example of standard</p> <p>IEC 61915-2</p>	<p>ISO 15745-1:2003, 3.11</p>
Product	<p>— Definition</p> <p>desired output or by-product of the processes of an enterprise</p> <p>Note 1 to entry: A product can be an intermediate product, end product or finished goods from a business perspective.</p> <p>— Comment</p> <p>In this notion of product, service is not included. The product is the result of a process and object of trade.</p> <p>— Examples of standard</p> <p>IEC 62683-1</p> <p>IEC 61987-1</p>	<p>IEC 62264-1:2013, 3.1.27</p>
Tool	<p>— Examples of item</p> <p>Milling tool</p>	
Application		
Process	<p>— Examples of item</p> <p>Batch</p>	
Service	<p>distinct part of the functionality that is provided by an entity through interfaces</p>	<p>ISO/TS 19103:2015, 4.32</p>

Table 5 (continued)

Possible values	Explanation	Source documents
Interface	<p>— Definition</p> <p>feature (hardware or software) that enables objects to cooperate</p> <p>shared boundary between two functional units, defined by various characteristics pertaining to the functions, physical interconnections, signal exchanges, and other characteristics, as appropriate</p> <p>shared boundary between two or more systems, or between two or more elements within a system, through which information is conveyed</p> <p>— Examples of item</p> <p>Networks, gateways</p> <p>— Examples of standard</p> <p>IEC/TR 62541-1</p> <p>IEC 62453-1</p>	<p>ISO/IEC 2382:2015, 2124351</p> <p>ISO/IEC 10859:1997, 1.4.1.2</p>
Data	<p>— Examples of standard</p> <p>ISO/TS 8000-1</p>	
Information	<p>— Examples of standard</p> <p>ISO 10303 series</p>	
Ontology	<p>— Examples of standard</p> <p>IEC 61360-1</p> <p>ISO 13584 series</p> <p>ISO 22745 series</p>	

7.4 Type of standard

7.4.1 Short description

The facet “Type of standard” defines the focus of the standard or of the part of standard.

7.4.2 Possible values

[Table 6](#) describes the possible values of “Type of standard”.

Table 6 — Possible values of “Type of standard”

Possible values	Explanation
Terminology	<p>“Terminology” covers:</p> <ul style="list-style-type: none"> — terminology — glossary
Overview	
Model	
Framework	Elements, rules and flows.
Architecture	

Table 6 (continued)

Possible values	Explanation
Language	— Examples of item UML, XML, EXPRESS — Examples of standard IEC 61131-3 IEC 61499-2
Design requirements	
Test requirements	
Design and test requirements	

7.4.3 Comments

The components of enterprise-reference architectures are engineering methodologies, modelling languages, generic elements, (partial and particular) models, (computer-based) tools, modules, and enterprise-operational systems (see ISO 15704).

7.5 Sector

7.5.1 Short description

The facet “Sector” describes a grouping based on similar production processes, similar products, similar activities or similar behaviour in financial markets.

7.5.2 Possible values

[Table 7](#) describes the possible values of “Sector”.

Table 7 — Possible values of “Sector”

Possible values	Explanation
Any	
Text	Sector from a recognized taxonomy.

7.5.3 Comments

The classification or taxonomy used can vary according to the standard.

It can be the type of production process: discrete manufacturing process; batch process; continuous process.

The segmentation can rely on the end markets: residential; industry; energy and infrastructure; buildings; data centres & networks.

It can be the classification of sectors from the European Commission\Enterprise and Industry: aeronautic industries; automotive; biotechnology; chemicals; construction; defence industries; electrical engineering; food industry; footwear; furniture; healthcare industries; information and communication technologies; leather; legal metrology and pre-packaging; maritime industries; mechanical engineering; mining; metals and minerals; pressure equipment and gas appliances; radio and telecommunications terminal equipment (R&TTE); security research and development; space; textiles and clothing; tourism; toys; wood, paper, printing.

The segmentation can be more detailed such as: robots; industrial automation; airport; automotive; hospital; marine; retail; hotels; packaging; material handling; hoisting; textile; hvac; it; lift; machines; rail; panel builders; electrical energy; wind farm; thermal power; nuclear; hydro; mining; minerals &

metals; cement; mining; food & beverages; milk; drinks; beer; biscuit; pet food; water; drinking water; wastewater; desalination; oil and gas; off-shore; on-shore; pipeline; refinery; tank farm; services; green buildings; fire safety.

It can be from the ISO ICS list: services, company organization, management and quality; administration, transport, sociology; mathematics, natural sciences; health care technology; environment, health protection, safety; metrology and measurement, physical phenomena; testing; mechanical systems and components for general use; fluid systems and components for general use; manufacturing engineering; energy and heat transfer engineering; electrical engineering; electronics; telecommunications, audio and video engineering; information technology, office machines; image technology; precision mechanics, jewellery; road vehicles engineering; railway engineering; shipbuilding and marine structures; aircraft and space vehicle engineering; materials handling equipment; packaging and distribution of goods; textile and leather technology; clothing industry; agriculture; food technology; chemical technology; mining and minerals; petroleum and related technologies; metallurgy; wood technology; glass and ceramics industries; rubber and plastic industries; paper technology; paint and colour industries; construction materials and building; civil engineering; military engineering; domestic and commercial equipment, entertainment, sports.

7.6 Interoperability approach

7.6.1 Short description

The facet “Interoperability approach” describes the manner in which interoperability problems are solved and barriers are overcome.

7.6.2 Possible values

[Table 8](#) describes the possible values of “Interoperability approach”.

Table 8 — Possible values of “Interoperability approach”

Possible values	Explanation
Integration	A common form is used to represent the exchanged entities.
Federation	Standardized interfaces are defined to ensure the communication and interoperability between applications developed independently.
Unification	A common meta-model, which is applicable for the participating entities and used as a common reference to map existing models' syntax and semantics, is identified and detailed.

7.6.3 Comments

7.6.3.1 Examples

- “unification” for ISO 15704, which addresses the unification approach with the definition of a reference architecture and the building up of constructs (e.g. partial models);
- “federation” for IEC 62264, which addresses explicitly the federation approach with the definition of a standardized interface;
- “federation” for ISO 15745 and ISO 16100;
- “integration” or “unification” for the ISO 10303 series. STEP defines a full integrated approach, but some of its parts are used as constructs in systems and other standards, then they participate to the unification approach.

7.6.3.2 Additional explanations

Additional explanations are given in ISO 11354-1, ISO 14258:1998, 3.8.2, and ISO 15704.

ISO 11354-1 states the following:

— In the integrated approach a common form is used to represent the exchanged entities. This common form is sufficiently expressive to capture those details that affect interoperability of the items to be exchanged, rather than the process or system as a whole. The common form is not necessarily an International Standard, but is agreed by participating enterprises in order to elaborate these entities and build systems accordingly.

— In the federated approach, there is no sufficiently capable common form or meta-model to guide the interaction between enterprises that interoperate. The lack of capability is often related to different terminologies or methodologies that are resolved by business entity interaction. While there can be a common understanding between the business entities, in the federated approach, no business entity imposes their own models, languages and methods of work.

— In the unified approach, a common meta-model, which is applicable for the participating entities and used as a common reference to map existing models' syntax and semantics, is identified and detailed. This meta-model provides at least a reference vocabulary, but could be a complete ontology. Such a meta-model is not an executable entity. Instead, it provides a means for semantic equivalence to enable mapping between entities. Using this meta-model, a translation between the constituent entities is then possible. However, that translation might involve the loss of some information because the participating entities can have different extensions or instantiations of the same meta-model.

7.7 Interoperability barrier

7.7.1 Short description

The facet “Interoperability barrier” describes the incompatibility between entities within the enterprise that obstructs the exchange of information and other entities, the utilization of services or the common understanding of exchanged items.

7.7.2 Possible values

[Table 9](#) describes the possible values of “Interoperability barrier”.

Table 9 — Possible values of “Interoperability barrier”

Possible values	Explanation
Not applicable	Tbd
Conceptual	Conceptual barriers relate to the differences in the expression, definition, and understanding of exchanged items at various levels of abstraction, e.g. mismatched enterprise models of a company.
Technological	Technological barriers relate to one or more technological discontinuities somewhere along the item exchange path.
Organizational	Organizational barriers relate to the allocation of responsibility and authority, and the execution or regulation of decision-making and operational activities.

7.7.3 Comments

ISO 11354-1 states that the interoperability barrier viewpoint describes the incompatibilities and mismatches that obstruct the sharing and exchanging of information and other entities. Three kinds of barriers are described: conceptual, technological, and organizational.

The notion of conceptual or technological comes also from engineering design where one distinguishes between conceptual design and technical design. A conceptual barrier describes incompatibilities that

are independent from any technology, whereas technological barriers specify mismatches that are due to the implemented technology.

- Conceptual barriers: conceptual barriers are detailed in terms of the syntactic, semantic, and semiotic incompatibilities of exchangeable items, particularly information and other knowledge assets.
 - Syntactic incompatibility occurs whenever different people or systems use different expressions to represent information and knowledge. For example, service syntactic incompatibility occurs when there is a difference in the syntax used for the description of the service required and provided.
 - Semantic incompatibility occurs whenever the meaning of exchanged items is not sufficiently similar. In this case, there is no clearly defined common meaning to enable unambiguous interpretation of the information content. For example, process semantic incompatibility occurs when there is a difference in the semantics used in different process modelling languages.
 - Semiotic incompatibility occurs when participating entities interpret the exchanged items, concerning both artefacts and relationships, differently in different contexts. For example, business semiotic incompatibility occurs when there is a difference in the partners' business vision and culture, value expectations or operational concepts.
- Technological barriers: in the use of ICT to communicate and exchange information, a significant technological barrier for enterprise interoperation involves incompatible interfaces between the different systems, which can be enterprises, human-being interactions or computer systems. These incompatibilities often result from different choices among standardized technologies that prohibit the sharing and exchanging of information between the systems involved. The following are examples of technological barriers:
 - physical manifestations barriers, e.g. different part and product handling due to dimensions and materials of fixtures, magazines and packing materials;
 - power conversion and consumption barriers, e.g. different line voltage and power transformation technology;
 - material logistics barriers, e.g. different storage and transportation requirements;
 - communication barriers, e.g. incompatibility of the protocols used to exchange information or to search and discover a service provider;
 - information barriers, e.g. different techniques used to represent information, or incompatibility in the tools used to encode/decode the information being exchanged;
 - infrastructure barriers, e.g. use of different incompatible middleware platforms, different database technologies and coding techniques, incompatible process execution engines and platforms, differences in ICT infrastructure support.
- Organizational barriers: when responsibility in an enterprise is not clearly and explicitly defined, interoperation between two systems is more difficult or obstructed completely. Without defining who is authorized to create, modify and maintain exchange content, assurance of the integrity of data, processes, services, etc. is almost impossible. These barriers are related to human and organizational behaviour. Indeed, when two enterprises have different organizational structures (e.g. hierarchical versus matrix authority) and decision processes, mappings are likely to be needed before the two enterprises can interoperate. The organizational barriers are detailed in terms of the incompatibilities of organizational structures, management techniques and policies implemented in the enterprises attempting to interoperate. The following are examples of organizational barriers:
 - responsibility incompatibility occurs when interaction participants are unable to identify the person or organizational unit associated with an exchanged item (e.g. who is to be called if the data transmission is not received within the specified time frame?);

- authority incompatibility occurs when interaction participants are unable to identify the person or organizational unit capable of committing exchange resources or qualifying exchange results;
- decision-making incompatibility occurs when the decision processes of interaction participants have different time horizons or different decision parameters with respect to the exchange items;
- policy incompatibility occurs when enterprises have different and incompatible policies affecting areas of their interaction, e.g. different database management, different security policies or different policies for management of service provision;
- process organizational incompatibility occurs when enterprises have different process structuring mechanisms, configurations and managements, or different process granularities and scopes;
- regulatory incompatibility is a kind of barrier that involves interaction with a third party who controls or constrains some aspect of exchange authority; this control can dictate which items of exchange are necessary or required for a particular interaction between two enterprises."

7.8 Interoperability concern

7.8.1 Short description

The facet “Interoperability concern” describes the aspect of interaction or interoperation that is of interest to an enterprise stakeholder.

7.8.2 Possible values

[Table 10](#) describes the possible values of “Interoperability concern”.

Table 10 — Possible values of “Interoperability concern”

Possible values	Explanation
Business (system)	Business interoperation occurs when a particular business is understood and shared without ambiguity among interacting partners. It can be interpreted as context.
Process (application, scenario)	Process interoperation occurs when either: — a particular process is capable of receiving and using needed information provided by an external process, or conversely; — an external process is capable of receiving and using needed information from a process within the enterprise.
Service	Service interoperation occurs when either: — a particular service is capable of receiving and using needed information provided by an external service, or conversely; — an external service is capable of receiving and using needed information from a service within the enterprise. It can be interpreted as conveyance.
Data	Data interoperation occurs when either — a particular entity is capable of receiving and using needed information provided by an external source, or conversely; — an external source is capable of receiving and using needed information from an entity within the enterprise. It can be interpreted as content.

7.8.3 Comments

ISO 11354-1 states that:

- The interoperability concern viewpoint describes the kinds of concerns that are relevant for enterprise interoperability.
- Data are used by services. Services are employed by processes to realize the business of the enterprise. From another perspective, the goal of an enterprise is to run its business. The business is realized through processes. Processes employ services that in turn need data to perform activities.

7.9 Conformity

The facet “Conformity” consists in a complete list of identical asset properties matching the system requirements. It can be specified as profile or list of profiles.

7.10 Point of view

The facet “Point of view” covers the need of timelines, the user focus keywords and permits comparison of standards addressing the same object.

7.11 Genericity

7.11.1 Short description

ISO 19439:2006, 5.4.1, states that the concept of genericity supports the establishment of a reference catalogue of re-usable generic modelling language constructs that can be specialized and aggregated into industry- and sector-specific models (partial models) to represent and satisfy common patterns of requirement or design. These generic modelling language constructs and partial models can be used (instantiated and specialized) in the development of models for particular enterprises.

It only applies when the type of standard is a modelling language.

7.11.2 Possible values

[Table 11](#) describes the possible values of “Genericity”.

Table 11 — Possible values of “Genericity”

Possible values	Explanation
Not applicable	When the component is not a modelling language.
Generic	<p>The generic level comprises a collection of modelling language constructs that can be used to build partial models and particular models for specific enterprises. Modelling language constructs described at this level have the widest application in the representation of enterprise domains.</p> <p>— Examples of standard</p> <p>STEP Module and Resource Library ISO 10303 IEC 61508</p>
Partial	<p>The partial level contains sets of partial models, each one being applicable to a specific kind of industry sector or industrial activity. A partial model is a re-usable reference model that allows the user to capture and re-use concepts common to many enterprises, and thereby to increase the efficiency of modelling. Partial models still need adaptation to the requirements of the specific enterprise.</p> <p>— Examples of standard</p> <p>ISO 10303-236 (STEP AP212) IEC 61784-3</p>
Particular	<p>The particular level is concerned solely with one particular enterprise domain. It embodies all necessary knowledge of that enterprise in a way that can be used directly for the identification, specification, implementation, operation and later decommissioning of its enterprise operation.</p> <p>— Examples of standard</p> <p>ISO 10303-236 (STEP AP236) IEC 61784-3-2</p>

7.11.3 Comments

ISO 19439:2006, 3.49 states that modelling language construct is a textual or graphical part of a modelling language devised to represent, in an orderly way, the diverse information on common properties and elements of a collection of phenomena.

NOTE A modelling language construct is a basic architectural entity at the generic level that is designed to be re-used in a wide range of applications. As a part of a modelling language, “it models common features of structure and/or behaviour in a modelled domain.”

A language construct can also be defined as a syntactically allowable part of a program that may be formed from one or more lexical tokens in accordance with the rules of a programming language.

7.12 Explicit relationship

7.12.1 Short description

The facet “Explicit relationship” is the list of the standards from the “Normative references” clause.

7.12.2 Possible values

[Table 12](#) describes the possible values of “Explicit relationship”.

Table 12 — Possible values of “Explicit relationship”

Possible values	Explanation
ISO xxxxx:yyyy	Dated reference to an ISO publication
ISO xxxxx	Undated reference to an ISO publication
IEC xxxxx:yyyy	Dated reference to an IEC publication
IEC xxxxx	Undated reference to an IEC publication
BBB xxxxx:yyyy	Dated reference to a publication from an standardization body
BBB xxxxx	Undated reference to a publication from an standardization body

7.12.3 Comments

The facet “Explicit relationship” can be used by a tool for highlighting the standards that are often referenced by other standards.

It applies more specifically to IEC-ISO cross-references.

7.13 Relation with other committees

7.13.1 Short description

The facet “Relation with other committees” characterizes the impact on the scope of other standardization committees or subcommittees.

7.13.2 Possible values

[Table 13](#) describes the possible values of “Relation with other committees”.

Table 13 — Possible values of “Relation with other committees”

Possible values	Explanation
Core	The publication is also in the scope of the committee. The publication could be for example developed by a joint working group with a liaison created between both committees.
Impacted	The publication is or will be referenced by publications or projects of the other committee. The other committee can be for example registered as: <ul style="list-style-type: none"> — “also for interest” in the project; — “the working documents shall be discussed by the other committee”; — “a liaison shall be created between both committees and the liaison expert shall participate to the working group meetings and report to his committee”. The other committee can provide comments to the committee that owns the project.
Information	

7.13.3 Comments

Complementary information such as the concerned working group, publication or project can be added between brackets.

Annex A (informative)

Visualizing the exploration of Big Picture data

Figures A.1 to A.6 illustrate various possible visualizations of Big Picture data as it is explored.

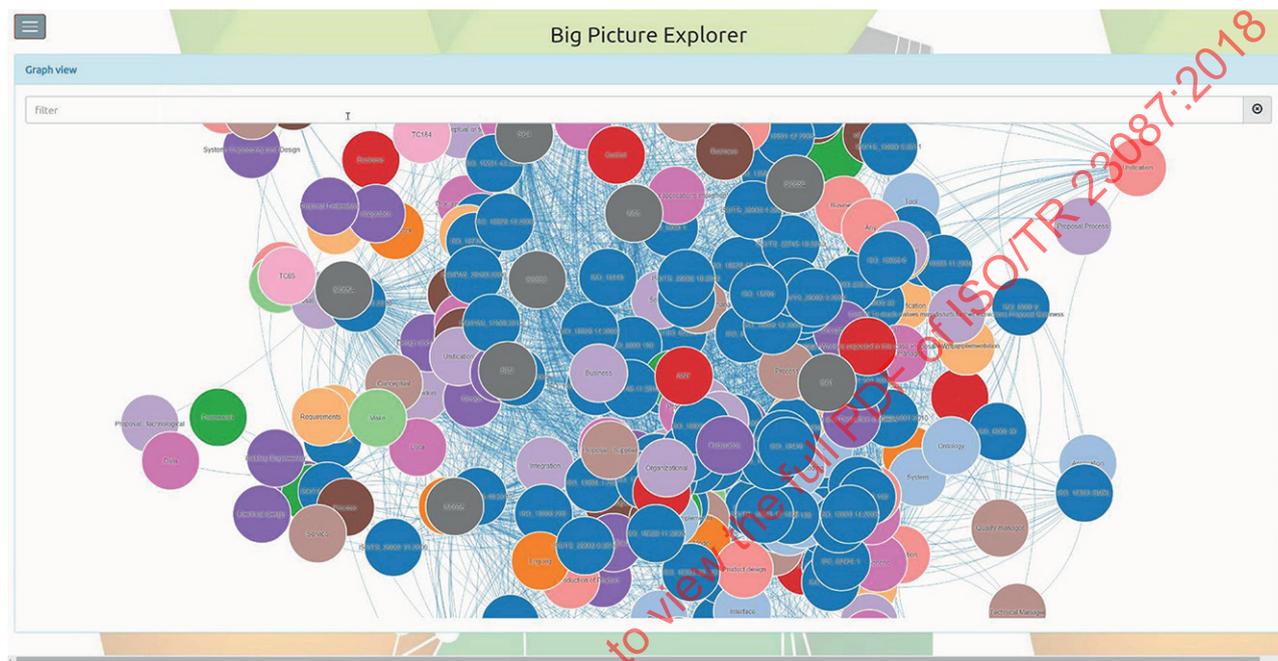


Figure A.1 — Graph — Nodes network

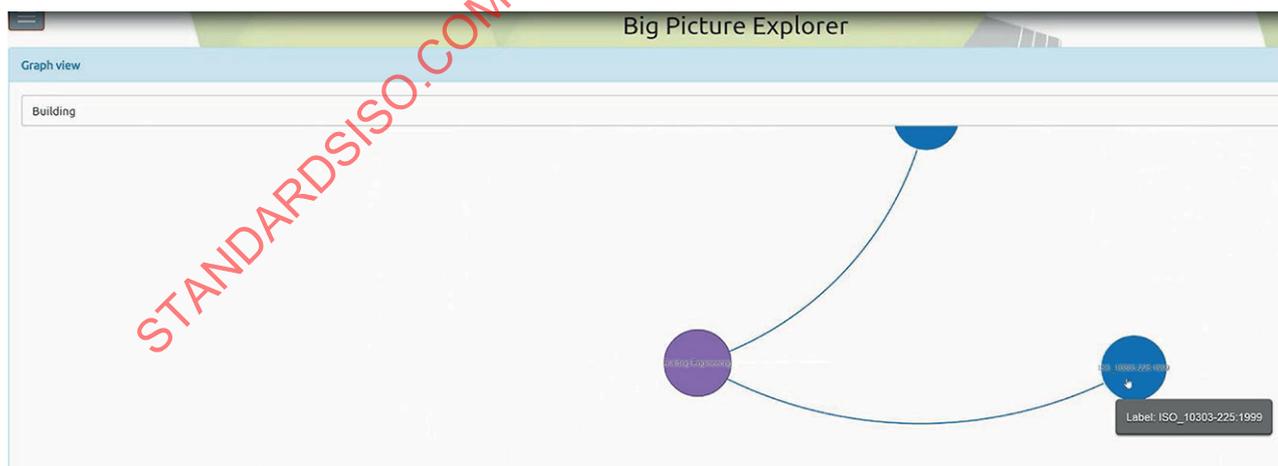


Figure A.2 — Graph — Nodes network filtered building

Big Picture Explorer

Spreadsheet

Show 10 entries

Search: Building

ID	Norme	Part	Standard	Object_of_standardization	Type_of_standard	Life_cycle	Value_chain	Enterprise_level	Sector	Approach	Barrier	Concern	Co
ISO_10303-225:1999	ISO10303	225	ISO 10303-225:1999 Industrial automation systems and integration – Product data representation and exchange – Part 225: Application protocol: Building elements using explicit shape representation	Data	Model	Design	Implementation	Whole	Business	Operations	Building Engineering	Design	Un
ISO_16739:2013	ISO16739		ISO 16739:2013 Industry Foundation Classes for data sharing in the construction and facility management industries	Data	Model	Design	Implementation	Whole	Business	Operations	Building Engineering	Design	Un

Showing 1 to 2 of 2 entries (filtered from 122 total entries)

Previous 1 Next

Figure A.5 — Table filtered building

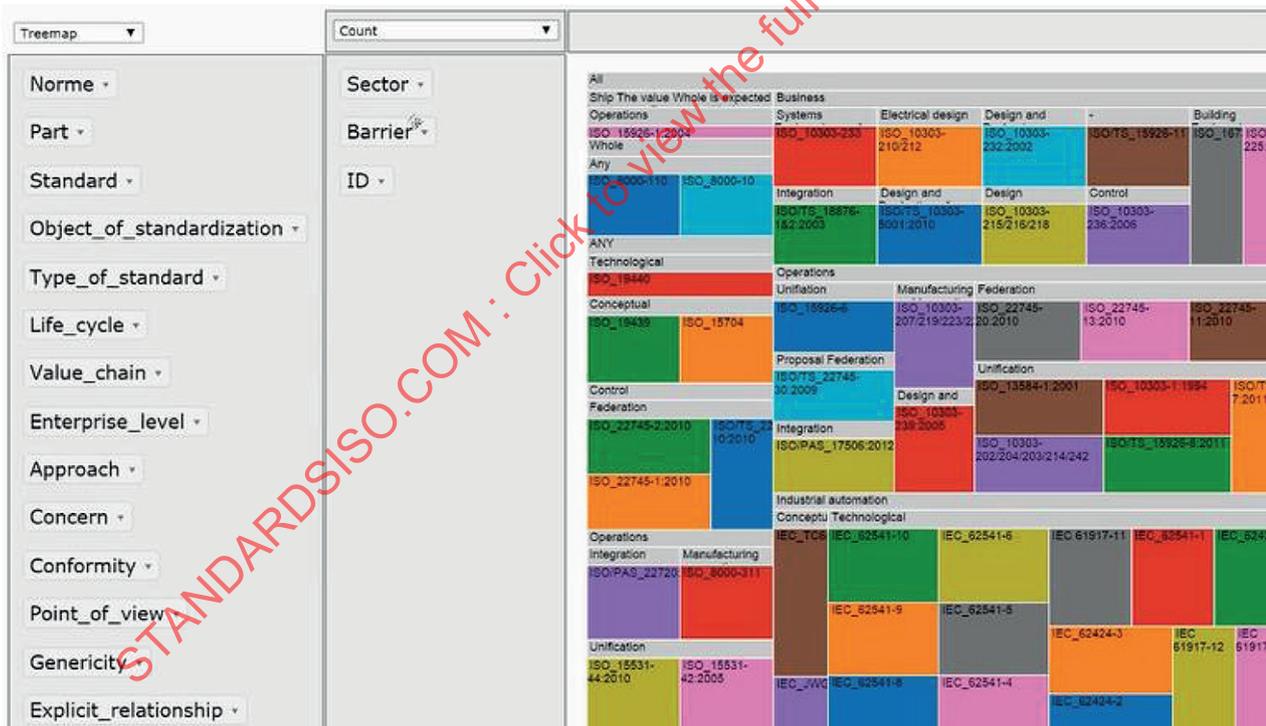


Figure A.6 — Tree map sector barrier

Annex B (informative)

Big Picture matrix

Table B.1 shows an example of a Big Picture matrix.

Table B.1 — Example of a Big Picture matrix

Publication	Object of standardization	Type of standard	Life cycle	Value chain	Enterprise level	Sector	Interoperability			Point of view	Genericity
							Approach	Barrier	Concern		
IEC 62264-1	Interface	Overview	Whole	Whole	Operations	Any	Federation	Conceptual	Process	System designer or manager	Generic
IEC 62264-2	Interface	Model	Whole	Whole	Operations	Any	Federation	Conceptual	Process	System designer or manager	Particular
IEC 62264-3	Interface	Model	Whole	Whole	Operations	Any	Federation	Conceptual	Process	System designer or manager	Particular
IEC 62264-5	Interface	Model	Whole	Whole	Operations	Any	Federation	Conceptual	Process	System designer or manager	Particular
IEC 61987-10	Product	Overview	Whole	Whole	Whole	Industrial automation	Federation	Technological	Data		Generic
IEC 61987-11	Product	Model	Whole	Whole	Whole	Industrial automation	Federation	Technological	Data		Partial
IEC 61987-12	Product	Model	Whole	Whole	Whole	Industrial automation	Federation	Technological	Data		Partial
IEC/TR 62837	System	Overview	Whole	Make	Operations	Industrial automation	Unification	Conceptual	Process		Generic
IEC/TS 62832-1	System	Model	Whole	Make	Operations	Industrial automation	Unification	Conceptual	Process		Generic
IEC 61360	—	—	—	—	—	—	—	—	—		—
IEC/TR 62541-1	Service	Overview	Implementation	Whole	Control	Industrial automation	Federation	Technological	Service		Generic, Particular A choice should be
IEC/TR 62541-2	Service	Model	Implementation	Whole	Control	Industrial automation	Federation	Technological	Service		Generic
IEC 62541-3	Data	Model	Implementation	Whole	Control	Industrial automation	Federation	Technological	Service		Particular
IEC 62541-4	Service	Model	Implementation	Whole	Control	Industrial automation	Federation	Technological	Service		Particular
IEC 62541-5	Information	Model	Implementation	Whole	Control	Industrial automation	Federation	Technological	Service		Particular
IEC 62541-6	Interface	Terminology	Implementation	Whole	Control	Industrial automation	Federation	Technological	Service		Particular
IEC 62541-7	Interface	Model	Implementation	Whole	Control	Industrial automation	Federation	Technological	Service		Particular
IEC 62541-8	Interface	Model	Implementation	Whole	Control	Industrial automation	Federation	Technological	Service		Particular

Table B.1 (continued)

IEC 62541-9	Interface	Model	Implementation	Whole	Control	Industrial automation	Federation	Technological	Service		Particular
IEC 62541-10	Application	Model	Implementation	Whole	Control	Industrial automation	Federation	Technological	Service		Particular
IEC 62714-1	Interface	Overview	Whole	Whole	Operations	Industrial automation	Federation	Technological	Data		Generic
IEC 62714-2	Interface	Terminology	Whole	Whole	Operations	Industrial automation	Federation	Technological	Data		Particular
IEC 62714-3	Interface	Model	Whole	Whole	Operations	Industrial automation	Federation	Technological	Data		Particular
ISO/TS 8000-1	Data	Overview	Whole	Whole	Enterprise	Any	Integration	Organizational	Data	Proposal: Quality manager	Generic
ISO 8000-2	Data	Terminology	Whole	Whole	Enterprise	Any	Integration	Organizational	Data	Proposal: Quality manager	Generic
ISO 8000-8	—	—	—	—	—	—	—	—	—		—
ISO 8000-60 ISO 8000-61 ISO 8000-62 ^a	Tool	Framework	Whole	Whole	Enterprise	Any	Integration	Technological	Data	Proposal: Quality manager	Generic
ISO 8000-100	Data	Overview	Whole	Whole	Enterprise	Any	Integration	Technological	Data	Proposal: Quality manager	Partial
ISO 8000-110	Data	Language	Whole	Whole	Enterprise	Any	Integration	Technological	Data	Proposal: Quality manager	Partial
ISO/TS 8000-120	Data	Terminology	Whole	Whole	Enterprise	Any	Integration	Technological	Data	Proposal: Quality manager	Partial
ISO 8000-130	Data	Terminology	Whole	Whole	Enterprise	Any	Integration	Technological	Data	Proposal: Quality manager	Partial
ISO 8000-140	Data	Terminology	Whole	Whole	Enterprise	Any	Integration	Technological	Data	Proposal: Quality manager	Partial
ISO/TS 8000-150	Data	Framework	Whole	Whole	Enterprise	Any	Integration	Technological	Data	Proposal: Quality manager	Partial
ISO/TS 8000-311	Tool		Whole	Whole	Enterprise	Any	Integration	Technological	Data	Proposal: Quality manager	Partial
ISO 10303-1	Data	Overview	Whole	Whole	Enterprise	Any	Unification	Conceptual	Data		Generic
ISO 10303-11	Tool	Language	Whole	Whole	Enterprise	Any	Unification	Technological	Data		Generic
ISO 10303-14	Tool	Language	Whole	Whole	Enterprise	Any	Unification	Technological	Data		Generic

Table B.1 (continued)

ISO 10303-21 ISO 10303-22 ISO 10303-23 ISO 10303-24 ISO 10303-25 ISO 10303-26 ISO 10303-27 ISO 10303-28	Interface These parts should be recorded separately	Language	Whole	Whole	Enterprise	Any	Unification	Technological	Data		Generic
ISO 10303- SMRL Stand- ard Module Resource Library	Data	Model	Whole	Whole	Enterprise	Any	Unification	Technological	Data		Generic
ISO 10303-242	These parts should be recorded separately	Model	Whole	Whole	Enterprise	Any	Unification	Technological	Data		Partial
ISO 10303-233	Data	Model	Design	Whole	Enterprise	Any	Unification	Technological	Data		Partial
ISO 10303-239	Data	Model	Whole	Whole	Enterprise	Any	Unification	Technological	Data		Partial
ISO 10303-207 ISO 10303-219 ISO 10303-223 ISO 10303-224 ISO 10303-238 ISO 10303-240	These parts should be recorded separately	Model	Implement- ation	Whole	Enterprise	Process Planning, Manufacturing and Inspection	Unification	Technological	Data		Partial
ISO 10303-215 ISO 10303-216 ISO 10303-218	These parts should be recorded separately	Model	Design, Implement- ation	Whole	Enterprise	Design	Unification	Technological	Data		Partial
ISO 10303-210 ISO 10303-212	These parts should be recorded separately	Model	Design, Implement- ation	Whole	Enterprise	electrical design, Production preparation	Unification	Technological	Data		Partial
ISO 10303-225	Data	Model	Design, Implement- ation	Whole	Enterprise	Building Engineering, Design	Unification	Technological	Data		Partial
ISO 10303-232	Data	Model	Design	Whole	Enterprise	Design and Packaging	Unification	Technological	Data		Partial
ISO 10303-236	Data	Model	Design	Whole	Enterprise	Design, manufacture	Unification	Technological	Data		Partial
ISO 10303-221 ISO 10303-227	These parts should be recorded separately	Model	Whole	Whole	Enterprise	Design, Manufacture Life Cycle	Unification	Technological	Data		Partial
ISO/TR 10303- 5001	Data	Model	Whole	Whole	Enterprise	Design and Production of Gears	Unification	Technological	Data		Partial
ISO 13584-1	Ontology	Overview	Whole	Whole	Enterprise	—	Unification	Organizational	Data	Supplier, Design engineer	Generic
ISO 13584-20	Ontology	Model	Whole	Whole	Operations	—	Unification	Organizational	Data	Supplier, Design engineer	Generic
ISO 13584-24	Ontology	Model	Whole	Whole	Operations	—	Unification	Organizational	Data	Supplier, Design engineer	Generic

Table B.1 (continued)

ISO 13584-25	Ontology	Model	Whole	Whole	Operations	—	Unification	Organizational	Data	Supplier, Design engineer	Generic
ISO 13584-26	Ontology	Model	Whole	Whole	Operations	—	Unification	Organizational	Data	Supplier, Design engineer	Generic
ISO 13584-31	Interface	Language	Whole	Whole	Operations	—	Unification	Organizational	Data	Supplier, Design engineer	Generic
ISO 13584-32	Tool	Language	Whole	Whole	Operations	—	Unification	Organizational	Data	Supplier, Design engineer	Generic
ISO/TS 13584-35	Interface	Language	Whole	Whole	Operations	—	Unification	Organizational	Data	Supplier, Design engineer	Generic
ISO 13584-42	Tool	Language	Whole	Whole	Operations	—	Unification	Organizational	Data	Supplier, Design engineer	Generic
ISO 13584-101	Tool	Model	Whole	Whole	Operations	—	Unification	Organizational	Data	Supplier, Design engineer	Particular
ISO 13584-102	Tool	Model	Whole	Whole	Operations	—	Unification	Organizational	Data	Supplier, Design engineer	Particular
ISO 13584-501	Service	Model	Whole	Whole	Operations	—	Unification	Organizational	Data	Supplier, Design engineer	Particular
ISO 13584-511	Ontology	Model	Whole	Whole	Operations	—	Unification	Organizational	Data	Supplier, Design engineer	Particular
ISO 14306	Data	Model	Whole	Whole	Operations	—	Federation	Technological	Data		Partial
ISO 15531-1	System	Overview	Whole	Make	Operations	—	Unification	Conceptual	Process	Production management	Partial
ISO 15531-31	System	Model	Whole	Make	Operations	—	Unification	Conceptual	Process	Production management	Partial
ISO 15531-32	System	Model	Whole	Make	Operations	—	Unification	Conceptual	Process	Production management	Partial
ISO 15531-42	Data	Model	Whole	Make	Operations	—	Unification	Conceptual	Process	Production management	Partial
ISO 15531-43	Process	Model	Whole	Make	Operations	—	Unification	Conceptual	Process	Production management	Partial
ISO 15531-44	Data	Model	Whole	Make	Operations	—	Unification	technological	Process	Production management	Partial
ISO 15926-1	Data	Overview	Whole	Whole	Enterprise	oil_and_gas	Federation	Conceptual	Data		Generic
ISO 15926-2	Data	Model	Whole	Whole	Enterprise	—	Federation	Conceptual	Data		Generic
ISO/TS 15926-3	Data	Model	Whole	Whole	Enterprise	—	Federation	Conceptual	Data		Generic
ISO/TS 15926-4	Data	Model	Whole	Whole	Enterprise	—	Federation	Conceptual	Data		Partial