



International Society of Automation
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STANDARD

American National Standard
ANSI/ISA-95.00.01-2025
(IEC 62264-1 Mod)

This standard is intended for worldwide use in all industries as applicable.

**Enterprise-Control System
Integration – Part 1: Models
and Terminology**

Approved: 12 FEBRUARY 2025

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Enterprise-Control System Integration – Part 1: Models and Terminology

ISBN: 978-1-64331-270-5

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ENTERPRISE-CONTROL SYSTEM INTEGRATION –

Part 1: Models and terminology

FOREWORD

This foreword, as well as all footnotes and annexes, is included for information purposes and is not part of ANSI/ISA-95.00.01-2025 (IEC 62264-1 Mod).

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This Part 1 standard is structured to follow International Electrotechnical Commission (IEC) guidelines. This revised Part 1 replaces ANSI/ISA-95.00.01-2010 (IEC 62264-1 Mod).

This document is Part 1 of a multi-part set of standards that defines the information exchange interface between enterprise activities and control activities.

As currently envisioned, the ANSI/ISA-95 series will consist of the following parts under the general title, Enterprise-Control System Integration:

- Part 1: Models and Terminology
- Part 2: Objects and Attributes for Enterprise-Control System Integration
- Part 3: Activity Models of Manufacturing Operations Management
- Part 4: Objects and Attributes for Manufacturing Operations Management Integration
- Part 5: Business-to-manufacturing Transactions
- Part 6: Messaging Service Model
- Part 7: Alias Service Model
- Part 8: Information Exchange Profiles
- TR01: Master Data Profile Template

INTRODUCTION

This is a revision of ISA-95.00.01-2010. The major changes made to this standard from the previous version are:

- 1) The starting point for the update was IEC 62264-1, *Enterprise-control system integration – Part 1: Models and terminology*, Edition 2. This was based on the published IEC/ISO version of this standard, IEC 62264.01.
- 2) Figure 7 has been updated to reflect specific functions in the enterprise, highlight the specific boundary between enterprise and manufacturing and control domains, and remove information flow labels that were inconsistent with subsequent details of the standard.
- 3) Clause 6.4 and Clause 6.5 were updated to reflect changes to Figure 7.
- 4) Clauses 5.2.4.2 to 5.2.4.13 were moved to Annex D5 and are informational.

This Part 1 standard is limited to describing the relevant functions in the enterprise and the manufacturing and control domains and which information is normally exchanged between these domains. Subsequent parts will address how this information can be exchanged in a robust, secure, and cost-effective manner, preserving the integrity of the complete system. For purposes of this standard, the manufacturing and control domain includes manufacturing operations management systems, manufacturing control systems, and other associated systems and equipment associated with manufacturing. The terms “enterprise,” “controls,” “process control,” and “manufacturing” are used in their most general sense and are held to be applicable to a broad sector of industries.

This Part 1 standard provides standard models and terminology for describing the interfaces between the business systems of an enterprise and its manufacturing operations and control systems. The models and terminology presented in this standard:

- a) emphasize good integration practices of control systems with enterprise systems during the entire life cycle of the systems;
- b) can be used to improve existing integration capabilities of manufacturing operations and control systems with enterprise systems; and
- c) can be applied regardless of the degree of automation.

Specifically, this standard provides a standard terminology and a consistent set of concepts and models for integrating control systems with enterprise systems that will improve communications between all parties involved. Some of the benefits produced will:

- a) reduce users' times to reach full production levels for new products;
- b) enable vendors to supply appropriate tools for implementing integration of control systems to enterprise systems;
- c) enable users to better identify their needs;
- d) enable system suppliers and integrators to offer the right applications and services;
- e) enable users and suppliers to exchange data in a common semantic context;
- f) reduce the costs of automating manufacturing processes;
- g) optimize supply chains;
- h) reduce life-cycle engineering efforts; and
- i) support the standardization toward digital integration.

This Part 1 standard is intended for those who are:

- a) involved in designing, building, or operating manufacturing facilities;
- b) responsible for specifying interfaces between manufacturing and process control systems and other systems of the business enterprise;
- c) involved in designing, creating, marketing, and integrating automation products used to interface manufacturing operations and business systems; or
- d) involved in specifying, designing or managing product creation, movement and storage within manufacturing enterprises.

It is not the intent of this standard to:

- suggest that there is only one way of implementing integration of control systems to enterprise systems;
- force users to abandon their current methods of handling integration; or
- restrict development in the area of integration of control systems to enterprise systems.

This Part 1 standard discusses the interface content between manufacturing-control functions and other enterprise functions. This standard presents a partial model or reference model as defined in ISO 15704. The first three clauses are normative and present the *scope* of the standard, *normative references*, and *definitions*, in that order.

The scope of this part is limited to describing the relevant functions in the enterprise and the manufacturing and control domain and which information is normally exchanged between these domains. Subsequent parts will address how this information can be exchanged in a robust, secure, and cost-effective manner preserving the integrity of the complete system.

Clause 4 is informative. The intent is to describe the context of the models in Clause 5 and Clause 6. It gives the criteria used to determine the scope of the manufacturing operations and control system domain. Clause 4, being informative, does not contain the formal definitions of the models and terminology but describes the context to understand the other clauses.

Clause 5 is normative. The intent is to describe hierarchy models of the activities involved in manufacturing-control enterprises. It presents in general terms the activities that are associated with manufacturing operations and control and the activities that occur at the business logistics level. It also gives an equipment hierarchy model of equipment associated with manufacturing operations and control. Clause 5.5 is informative. Clause 5, being normative, contains format definitions of the models and terminology.

Clause 6 is normative. The intent is to describe a general model of the functions within an enterprise that are concerned with the integration of business and control. It defines, in detail, an abstract model of control functions and, in less detail, the business functions that interface to control. The purpose is to establish a common understanding for functions and data flows involved in information exchange.

Clause 7 is normative. The intent is to define in detail the information that makes up the information streams defined in Clause 6. The purpose is to establish a common terminology for the elements of information exchanged. Clause 7, being normative, contains formal definitions of the models and terminology. The attributes and properties are not formally defined in this clause of the standard.

Clause 8 is normative. It provides a description of the categories of information structures that are exchanged between applications at Level 4 and those at Level 3. The clause also provides the information categories that are exchanged between the applications within Level 3.

Clause 9 is normative. It provides statements regarding the conformance of implementations, the compliance of specifications, and the completeness of these specifications and implementations relative to Part 1 of this standard.

Annex A is informative. It defines other related enterprise activities that are supportive of, but not directly related to, enterprise to control integration.

Annex B is informative. It provides listings of associated standards generally related to enterprise integration.

Annex C is informative. It describes business drivers and key performance indicators that are the reasons for the information exchange between business and control functions.

Annex D is informative. It provides an area for common questions and answers related to this part the standard.

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ENTERPRISE-CONTROL SYSTEM INTEGRATION –

Part 1: Models and terminology

1 Scope

This standard describes the interface content between manufacturing operations and control (MO&C) functions and other enterprise functions. The interfaces considered are the interfaces between Levels 3 and 4 of the hierarchical model defined by this standard. The goals are to increase uniformity and consistency of interface terminology and reduce the risk, cost, and errors associated with implementing these interfaces.

The standard can be used to reduce the effort associated with implementing new product offerings. The goal is to have enterprise systems and control systems that inter-operate and easily integrate.

The scope of this standard is limited to

- a) a presentation of the scope of the manufacturing operations and control domain;
- b) a discussion of the manufacturing operation management activities, their functions and interfaces;
- c) a discussion of the resources involved in manufacturing;
- d) a discussion of the structure and roles of physical assets of an enterprise involved in manufacturing;
- e) a listing of the functions associated with the interface between control functions and enterprise functions; and
- f) a description of the information that is shared between control functions and enterprise functions.

2 Normative references

The following referenced documents are indispensable for the application 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 61512-1:1997, *Batch control – Part 1: Models and terminology*

ISO/IEC 19501:2005, *Information technology - Open Distributed Processing - Unified Modeling Language (UML) - Version 1.4.2*

ISO 15704, *Industrial automation systems — Requirements for enterprise-reference architectures and methodologies*

3 Terms, definitions, and abbreviations

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply. Phrases in *italic* in lines following the preferred term in **bold** are considered as synonyms.

3.1.1

area

physical, geographical or logical grouping of resources determined by the site

NOTE It can contain process cells, production units, production lines, and storage zones.

3.1.2

available capacity

portion of the production capacity that can be attained but is not committed to current or future production

3.1.3

bill of lading

contract or receipt for goods that a carrier agrees to transport from one place to another and to deliver to a designated person or that it assigns for compensation upon the conditions stated therein

3.1.4

bill of material

listing of all the subassemblies, parts, and/or materials that are used in the production of a product including the quantity of each material required to make a product

NOTE The term product may refer to a finished product or an intermediate product

3.1.5

bill of resources

listing of all resources and when needed in the production process to produce a product

NOTE It is also a listing of the key resources required to manufacture a product, organized as segments of production and is often used to predict the impact of activity changes in the master production schedule on the supply of resources.

3.1.6

capability

ability to perform actions, including attributes on qualifications and measures of the ability as capacity

3.1.7

capacity

measure of the ability to take action, an aspect of a capability

EXAMPLE Measures of the production rates, flow rates, mass or volume.

3.1.8

certificate of analysis

certification of conformance to quality standards or specifications for products or materials

NOTE It can include a list or reference of analysis results and process information. It is often required for custody transfer of materials.

3.1.9

committed capacity

portion of the production capacity that is currently in use or is scheduled for use

3.1.10

consumables

resources that are not normally included in bills of material or are not individually accounted for in specific production requests or are not lot tracked

3.1.11

control domain

[see manufacturing operations and control domain]

3.1.12

enterprise

one or more organizations sharing a definite mission, goals and objectives to offer an output such as a product or service

3.1.13

equipment

role-based representation of the elements of the equipment hierarchy model including enterprise, site, area, work center, work unit, process cell, unit, production line, production unit, work cell, storage zone, and storage unit

3.1.14

finished goods

final materials on which all processing and production is completed

3.1.15

finished good waivers

approvals for deviation from normal product specifications

3.1.16

in-process waiver requests

requests for waivers on normal production procedures due to deviations in materials, equipment, or quality metrics, where normal product specifications are maintained

3.1.17

manufacturing operations management domain

domain that includes all the activities in Level 3 and information exchanged to and from Levels 1, 2, and 4

3.1.18

manufacturing operations and control domain

control domain

domain that includes all the activities and information exchanged in Levels 3, 2, and 1 and information exchanged to and from Level 4

3.1.19

process segment

business process segment

view of a collection of resources, which may include material, energy, personnel, or equipment with specific capabilities needed for a segment of production, independent of any particular product at the level of detail required to support business processes that may also be independent of any particular product

3.1.20

product definition

collection of information about resources, production rules and scheduling required to create a product. A product definition has an external reference to a bill of materials, a product production rule, and a bill of resources.

3.1.21

product segment

logical grouping of personnel resources, equipment resources, and material specifications required of a process segment to complete a production step for a specific product

3.1.22

production capability

ability of resources (personnel, equipment, material, and process segment) to perform production in the enterprise accounting for total of the current committed, available, and unattainable capacity of the production facility

3.1.23

production control

collection of functions that manages all production within a site or area

3.1.24

production line

work center that is a collection of equipment dedicated to the manufacture of a specific number of products or product families

3.1.25

production rules

information used to instruct a manufacturing operation how to produce a product

3.1.26

production unit

work center that is a set of production equipment that converts, separates, or reacts one or more feedstocks to produce intermediate or final products

3.1.27

physical asset

physical object uniquely identified and tracked for maintenance and/or financial purposes

NOTE This standard addresses physical assets used in equipment roles. There are many other physical assets in an enterprise.

3.1.28

resource

enterprise entity that provides some or all of the capabilities required by the execution of an enterprise activity and/or business process (in the context of this standard, a collection of personnel, equipment, and/or material)

3.1.29

site

component of a manufacturing enterprise that is identified by physical, geographical, or logical segmentation

3.1.30

storage unit

work unit within a storage zone that is a designated physical space and/or equipment dedicated to the storage of materials and/or equipment

3.1.31

storage zone

work center that is a designated physical space and/or equipment dedicated to the storage of materials and/or equipment

3.1.32

unattainable capacity

portion of the production capacity that cannot be attained

NOTE Typically due to factors such as equipment unavailability, sub-optimal scheduling, or resource limitations.

3.1.33

work cell

work unit within a production line that consists of equipment grouped together to produce a family of parts having similar manufacturing requirements

3.1.34

work center

equipment element under an area in a role-based equipment hierarchy that performs production, storage, material movement, or any other Level 3 or Level 4 scheduled activity

3.1.35

work unit

equipment element under a work center in a role-based equipment hierarchy that performs production, storage, material movement, or any other Level 3 or Level 4 scheduled activity

3.2 Abbreviations

For the purposes of this standard, the following abbreviations apply.

BOL	Bill of lading
BOM	Bill of material
CIM	Computer integrated manufacturing
COA	Certificate of analysis
IIoT	Industrial internet of things
MESA	Manufacturing Enterprise Solutions Association
MO&C	Manufacturing operations and control
MOM	Manufacturing operations management
MRP	Materials requirements planning
MSDS	Material Safety Data Sheet
PRM	Purdue reference model
QA	Quality assurance
SOP	Standard operating procedure
UML	Unified Modeling Language (ISO/IEC 19501-1)

4 Enterprise-control system integration overview

Successfully addressing the issue of enterprise-control system integration requires identifying the boundary between the enterprise domain and the manufacturing operations and control domain. The boundary is identified using relevant models that represent functions, physical equipment, information within the manufacturing operations and control domain, and Information exchanged between the domains.

Multiple models show the functions and integration associated with manufacturing operations and control systems and enterprise systems.

- a) Hierarchy models that describe the logical levels of functions and domains of control associated within manufacturing organizations are presented in Clause 5. These models are based on *The Purdue Reference Model for CIM*, referenced as PRM; the MESA International Functional Model; and the equipment hierarchy model from IEC 61512-1. Detailed activity models of the manufacturing operations domain are given in Part 3.

NOTE See the Bibliography for reference to the MESA white paper defining MES functionality.

- b) A data flow model that describes the functional and data flows within manufacturing organizations is given in Clause 6. This model is also based on The Purdue Reference Model for CIM.
- c) An object model that describes the information that may cross the enterprise and control system boundary is given in Part 2.

This standard provides models and information in multiple levels of detail and abstraction. These levels are illustrated in Figure 1, which serves as a map to the rest of the document. Each model increases the level of detail presented in the previous model.

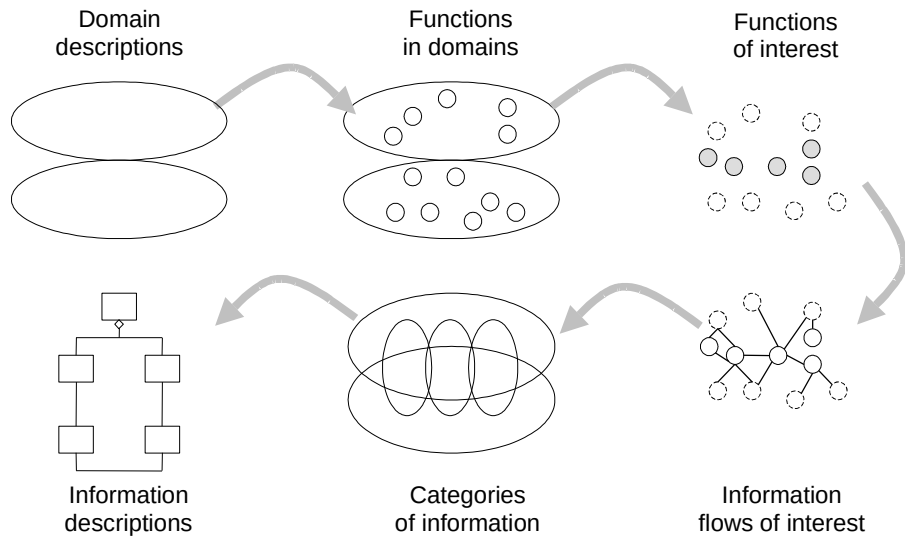


Figure 1 – Outline of models in the standard

The models start with a description of the domain of control systems and the domain of enterprise systems. The domain discussion is contained in Clause 5.

Functions within the domains are presented in Clauses 5 and 6. Functions of interest that are relevant to the standard are also given a detailed description in Clause 6. The Information exchanged of interest between the relevant functions are listed in 6.5.

The categories of information are given in Clause 8. The formal object model of the information of interest is presented in Part 2.

The information that flows between functions identified as being within the MO&C domain and those outside the MO&C domain describes the enterprise-control system boundary. Information exchanged between functions within the MO&C domain and information exchanged between functions outside the MO&C domain is outside the scope of this document. Figure 2 illustrates the enterprise-control system interface, as depicted in the data flow model, between control and non-control functions; the shaded circles indicate functions that exchange information and are described in the data flow model. Functions depicted as white circles and data flows depicted as dashed lines are those considered as outside the scope of this standard. Information exchanged of interest across the enterprise-control system boundary are given in Part 2 and Part 5. Some information exchanged within the manufacturing and operations domain are given in Part 4 and Part 6.

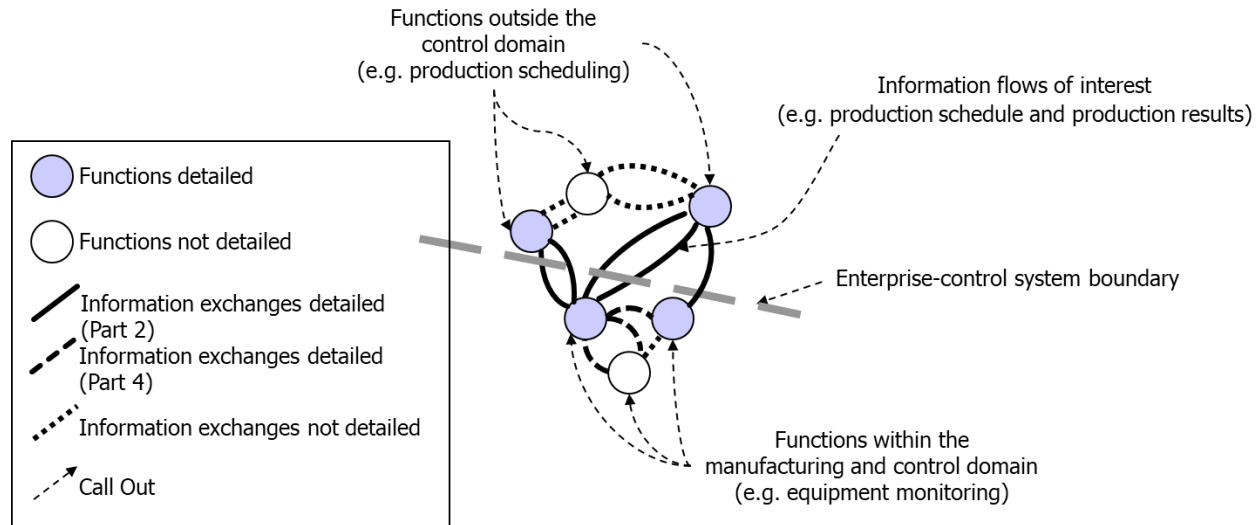


Figure 2 – Enterprise-control system interface

5 Hierarchy models

5.1 Hierarchy model introduction

Clause 5 presents the hierarchy models associated with manufacturing operations and control systems and other business systems. The hierarchy models are a functional hierarchy, a role-based equipment hierarchy, and a physical asset equipment hierarchy.

5.2 Functional hierarchy

5.2.1 Hierarchy levels

Figure 3 depicts the different logical levels of a functional hierarchy model: business planning and logistics, manufacturing operations and control, and batch, continuous, or discrete control. These levels provide different functions and work in different time frames. The interface addressed in this standard is between Level 4 and Level 3 of the hierarchy model. This is generally the interface between plant production scheduling and operation management and plant floor coordination.

This standard specifies that each level shall provide the functions listed below and illustrated in Figure 3.

- Level 0 defines the actual physical processes.
- Level 1 defines the activities involved in sensing and manipulating the physical processes. Level 1 typically operates on time frames of seconds and faster.
- Level 2 defines the activities of monitoring and controlling the physical processes. Level 2 typically operates on time frames of hours, minutes, seconds, and sub-seconds.
- Level 3 defines the activities of the work flow to produce the desired end products. It includes the activities of maintaining records and coordinating the processes. Level 3 typically operates on time frames of days, shifts, hours, minutes, and seconds.
- Level 4 defines the business-related activities needed to manage a manufacturing organization. Manufacturing-related activities include establishing the basic plant schedule (such as material use, delivery and shipping), determining inventory levels, and making sure that materials are delivered on time to the right place for production. Level 3 information is

critical to Level 4 activities. Level 4 typically operates on time frames of months, weeks, and days.

NOTE 1 There are other nonmanufacturing business-related activities that may be in Levels 1 through 4 or higher levels, but these are not defined in this standard, for example security activities.

NOTE 2 The terms function and activity are used as synonyms.

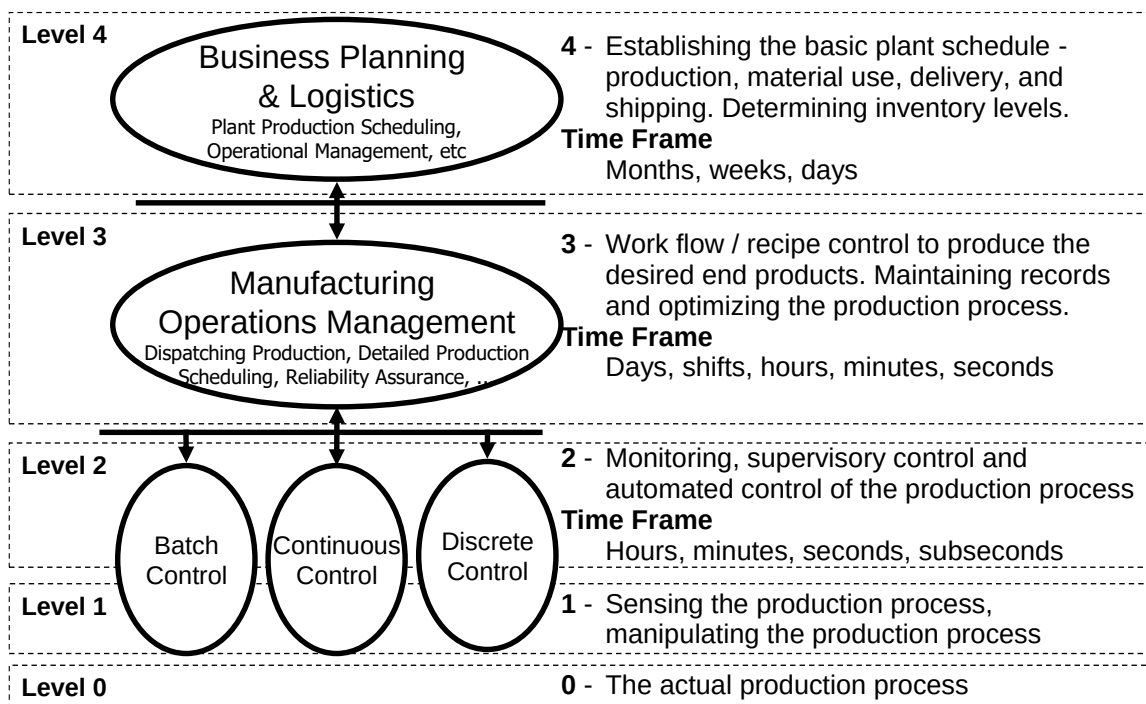


Figure 3 – Functional hierarchy

Levels 2, 1, and 0 present the cell or line supervision functions, operations functions, and process control functions and are not addressed in this standard. The discussion and labeling of levels is based on a historical description. Level 0 indicates the process, usually the manufacturing or production process. Level 1 indicates manual sensing, sensors, and actuators used to monitor and manipulate the process. Level 2 indicates the control activities, either manual or automated, that keep the process stable or under control. There are several different models for the functions at these levels based on the actual production strategy used.

For purposes of this standard the terminology manufacturing operations management (MOM) defines the Level 3 activities and information exchanged, and manufacturing operations and control define Level 1, 2, and 3 activities and information exchanged. The standard assumes all activities not explicitly presented as part of the MO&C domain to be part of the enterprise domain.

5.2.2 Criteria for inclusion in manufacturing operations and control domain

The criterion for defining the activities to be included as a Level 3, 2, or 1 activity shall be that the activity is directly involved in manufacturing and includes information about personnel, equipment, or material and meets any of the following conditions.

- The activity is critical to plant safety.
- The activity is critical to plant reliability.
- The activity is critical to plant efficiency.

NOTE 1 Absolute plant efficiencies may be dependent upon factors that are outside the control of a facility (MRP schedules, product mixes, etc.). These activities are not part of Level 3, 2, or 1.

d) The activity is critical to product quality.

e) The activity is critical to maintaining regulatory compliance.

EXAMPLE Maintaining regional, government and other agency compliance related to products and production.

NOTE 2 This includes such factors as safety, environmental, and current good manufacturing practices (cGMP) compliance.

NOTE 3 There are other criteria such as company policy and organizational structure, or the nature of the operations that could expand the scope of manufacturing operations management. See Annex A.

NOTE 4 Such activities as personnel management of salaries and job titles may be important for running a manufacturing business, but they are not considered part of manufacturing operations management.

5.2.3 Level 4

Level 4 activities typically include

- a) collecting and maintaining raw material and spare parts usage and available inventory, and providing data for purchase of raw material and spare parts;
- b) collecting and maintaining overall energy use and available inventory and providing data for purchase of energy source;
- c) collecting and maintaining overall goods in process and production inventory files;
- d) collecting and maintaining quality control files as they relate to customer requirements;
- e) collecting and maintaining machinery and equipment use and life history files necessary for preventive and predictive maintenance planning;
- f) collecting and maintaining manpower use data for transmittal to personnel and accounting;
- g) establishing the basic plant production schedule;
- h) modifying the basic plant production schedule for orders received, based on resource availability changes, energy sources available, power demand levels, and maintenance requirements;
- i) developing optimum preventive maintenance and equipment renovation schedules in coordination with the basic plant production schedule;
- j) determining the optimum inventory levels of raw materials, energy sources, spare parts, and goods in process at each storage point. These functions also include materials requirements planning (MRP) and spare parts procurement;
- k) modifying the basic plant production schedule as necessary whenever major production interruptions occur;
- l) planning production capacity, based on all of the above activities.

5.2.4 Level 3

5.2.4.1 Level 3 activities

Level 3 activities typically include

- a) reporting on area production including variable manufacturing costs based on the enterprise standard cost model;
- b) collecting and maintaining area data on production, inventory, manpower, raw materials, product quality, spare parts, and energy usage;
- c) performing of data collection and off-line analysis as required by engineering functions. This may include statistical quality analysis and related control functions;

- d) performing needed personnel functions such as: work period statistics (for example, time, task), vacation schedule, work force schedules, union line of progression, and in-house training and personnel qualification;
- e) establishing the immediate detailed production schedule for its own area including maintenance, transportation, and other production-related needs;
- f) locally optimizing the costs for its individual production area while completing the production schedule established by the Level 4 functions;
- g) modifying production schedules and work flows to compensate for plant production interruptions that may occur in its area of responsibility (i.e., downtime management, alternate production paths);
- h) managing manufacturing operations;
- i) managing maintenance on production equipment;
- j) managing laboratory and quality testing of materials;
- k) managing movement and storage of materials;
- l) transforming the business-oriented information used for Level 4-3 data exchanges into the manufacturing operations management-oriented information used within Levels 3 and below.

ISA-95.00.03 contains a detailed model that describes the activities in Level 3. More information on the activities associated with Level 3 can be found in Annex D.

5.3 Role-based equipment hierarchy

5.3.1 Role-based equipment hierarchy model

The physical assets of an enterprise involved in manufacturing are usually organized in a role-based hierarchical fashion as illustrated in Figure 4. Lower-level groupings are combined to form higher levels in the role-based hierarchy. In some cases, a grouping within one level may be incorporated into another grouping at that same level.

NOTE 1 The term role-based is applied to the equipment model to indicate that the hierarchy is defined in terms of the Level 3 and 4 functions and activities that equipment entities may perform. The actual physical location, composition, and relationships of the equipment entities are defined in a physical asset equipment hierarchy.

This model shows the areas of responsibility for the different function levels defined in the functional hierarchical model of Figure 3. The role-based equipment hierarchy model additionally describes some of the objects utilized in information exchange between functions.

The models may be collapsed or expanded as required for specific applications.

NOTE 2 Specific rules for collapsing and expanding these models are not defined in this standard. The following guidelines should be considered for collapsing and expanding the models.

1. Collapsing – Elements in the models may be omitted as long as the models remain consistent and the functions of the elements combined or removed are taken into account.
2. Expanding – Elements may be added to, or divided within, the models. When they are added between related elements, the integrity of the original relationship should be maintained. Elements may be divided to separately manage the resulting smaller elements.

The UML role-based equipment model defined in Part 2 of this standard is used to define the role-based equipment hierarchy information. The Part 2 UML model contains the rules used to construct the hierarchical models used in different manufacturing operations management scenarios.

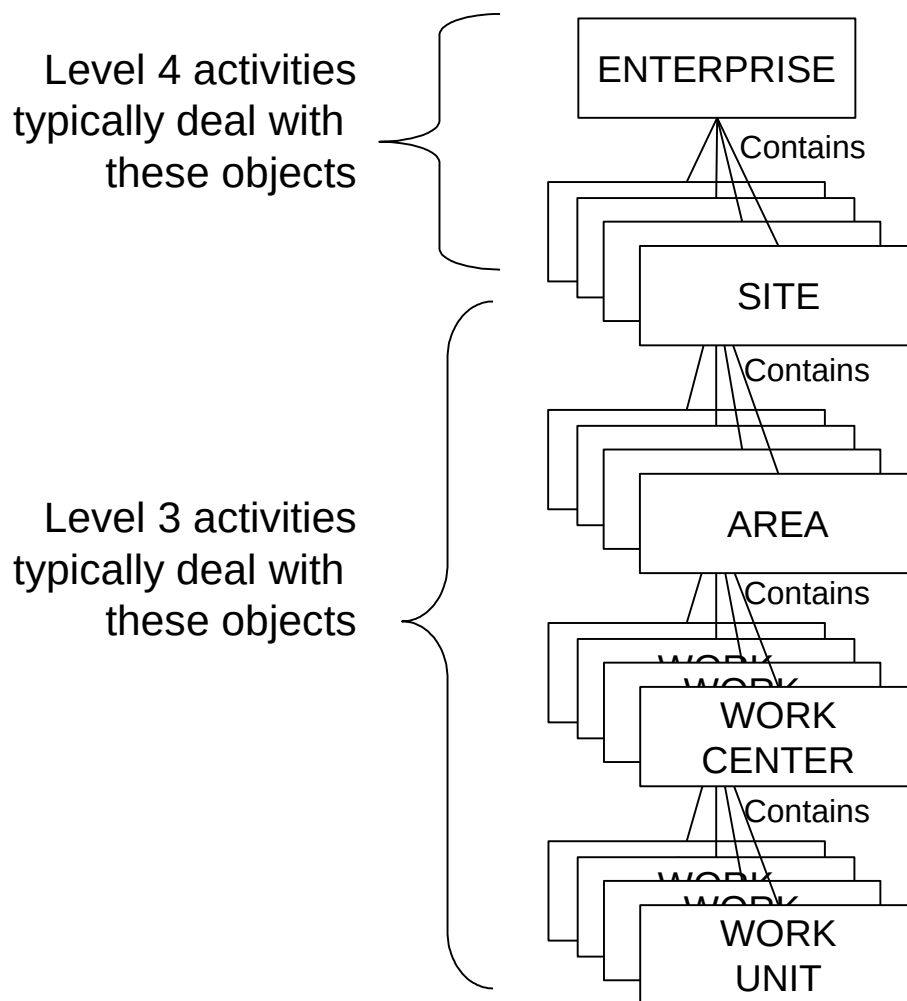


Figure 4 – Role-based equipment hierarchy

5.3.2 Enterprise

An enterprise is a collection of sites and areas and represents the top level of a role-based equipment hierarchy. The enterprise is responsible for determining what products will be manufactured, at which sites they will be manufactured, and in general how they will be manufactured.

Level 4 functions are generally concerned with the enterprise and site levels. However, enterprise planning and scheduling may involve areas, work centers, or work units within an area.

5.3.3 Site

A site is a physical, geographical, or logical grouping determined by the enterprise. It may contain areas, production lines, process cells, and production units. The Level 4 functions at a site are involved in local site management and optimization. Site planning and scheduling may involve work centers or work units within the areas.

A geographical location and main production capability usually identify a site. Sites generally have well-defined manufacturing capabilities.

NOTE For example, site identifiers from various industries are Dallas Expressway Plant, Deer Park Olefins Plant, and Johnson City Manufacturing Facility. Sites are often used for rough-cut planning and scheduling.

5.3.4 Area

An area is a physical, geographical, or logical grouping determined by the site. It may contain work centers such as process cells, production units, production lines, and storage zones. Most Level 3 functions occur within the area. The main production capability and geographical location within a site usually identify areas.

NOTE For example, area identifiers from various industries are CMOS Facility, North End Tank Farm, and Building 2 Electronic Assembly.

Areas generally have well-defined manufacturing capabilities and capacities. The capabilities and capacities are used for Level 3 and Level 4 planning and scheduling.

An area is made up of lower-level elements that perform the manufacturing functions. An area may have one or more of any of the lower-level elements depending upon the manufacturing requirements.

EXAMPLE 1 Many areas will have a combination of production lines for the discrete operations, production units for the continuous processes, and process cells for batch processes.

EXAMPLE 2 A beverage manufacturer may have an area with continuous mixing in a production unit, which feeds a batch process cell for batch processing, feeding a bottling line for a discrete bottling process.

Depending on the planning and scheduling strategy selected, the Level 4 functions may stop at the area level, or they may schedule the functions of the lower-level elements within the areas.

5.3.5 Work center and work unit

Work centers are elements of the equipment hierarchy under an area. The term work center may be used when the specific type of the equipment element is not significant for the purpose of the discussion.

For manufacturing operations management there are specific terms for work centers and work units that apply to batch production, continuous production, discrete or repetitive production, and for storage and movement of materials and equipment.

A work center is any equipment element subordinate to an area that may be defined by the user in an extension to the role-based equipment hierarchy model (See Figure 4). Types of work centers specifically defined in this part are process cells, production units, production lines, or storage zones, as shown in Figure 5.

The types of work centers may be extended when required for application specific role-based equipment hierarchies where the defined types do not apply. When a new type is added, it shall maintain the same relationship within the hierarchy as the defined work center types (within an area and contains work units).

EXAMPLE 1 A new work center type represents a distinct grouping of work units (a single work unit cannot belong to more than one work center).

EXAMPLE 2 Additional work center types are:

- Laboratory – used in quality operations
- Mobile Equipment Pool
- Unused Equipment Store – used in maintenance operations
- Transportation Center

NOTE 1 The role-based equipment hierarchy is an expansion of the equipment hierarchy model described in ANSI/ISA-88.01 and IEC 61512-1 and includes the definition of physical assets for discrete and continuous manufacturing, and for material storage.

NOTE 2 Extended work center types are outside the scope of this standard, and applications built using the extensions may not be interoperable.

A work unit is any element of the equipment hierarchy under a work center. Work units are the lowest form of elements in an equipment hierarchy that are typically scheduled by Level 3 functions. See Figure 5.

Work centers are typically the grouping of equipment scheduled by the Level 4 or Level 3 functions. Work centers have well-defined capabilities and capacities, and these are used for Level 3 functions. The capacities and capabilities are also often used as input to Level 4 business processes. Scheduling functions may identify specific work units.

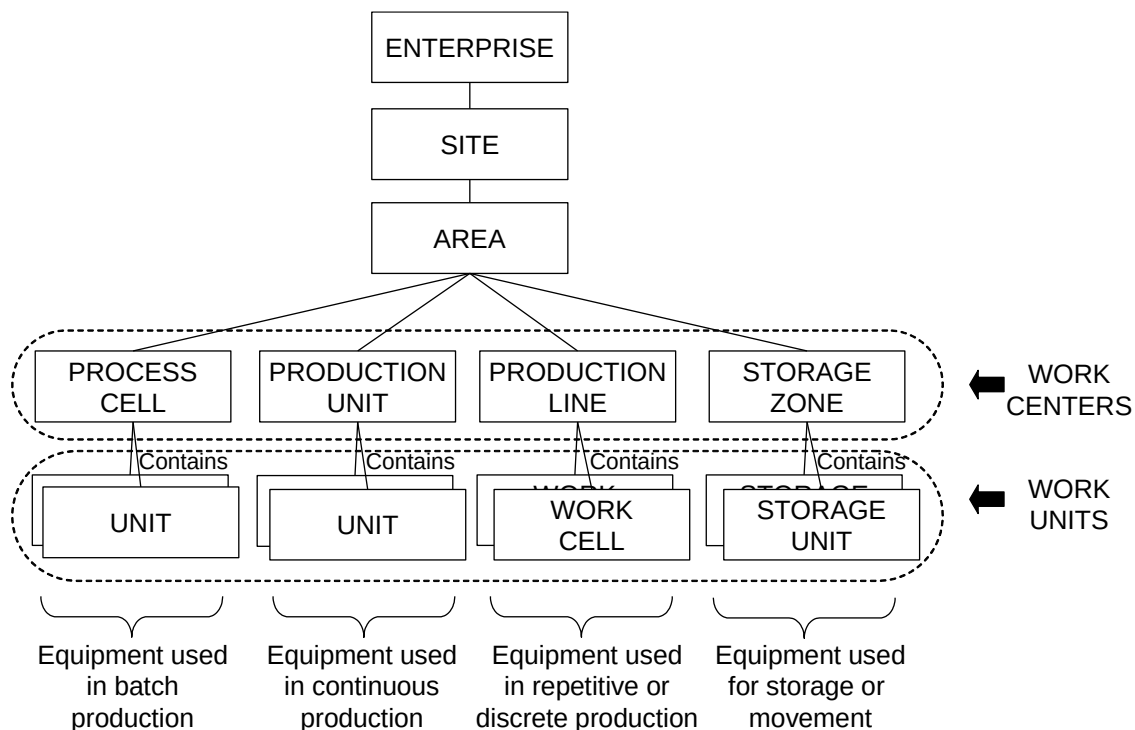


Figure 5 – Example of defined types of work centers and work units

NOTE 3 Material is also temporarily stored in process cells, production units, and production lines. This material is typically considered WIP and is usually distinct from inventory managed materials.

5.3.6 Production unit and unit

Production units and units are the lowest level of equipment typically scheduled by the Level 4 or Level 3 functions for continuous manufacturing processes. Production units are composed of units, and units are composed of lower-level elements, such as equipment modules, sensors, and actuators, but definitions of these are outside the scope of this standard. A production unit generally encompasses all of the equipment required for a segment of continuous production that operates in a relatively autonomous manner. It generally converts, separates, or reacts one or more feed stocks to produce intermediate or final products.

The major processing activity or product generated often identifies the production unit.

NOTE For example, production unit identifiers from various industries are Catalytic Cracker #1, Steam Cracker #59, and Alkylation Unit 2.

Production units and units have well-defined processing capabilities and throughput capacities, and these are used for Level 3 functions. The capacities and capabilities are also often used as input to Level 4 scheduling, even if the units are not scheduled by the Level 4 functions.

5.3.7 Production line and work cell

Production lines and work cells are the lowest levels of equipment typically scheduled by the Level 4 or Level 3 functions for discrete manufacturing processes. Work cells are usually only identified when there is flexibility in the routing of work within a production line. Production lines and work cells may be composed of lower-level elements, but definitions of these are outside the scope of this document.

The major processing activity often identifies the production line.

NOTE For example, production line identifiers from various industries are Bottling Line #1, Capping Line #15, CMOS Line #2, and Water Pump Assembly Line #4.

Production line and work cells have well-defined manufacturing capabilities and throughput capacities, and these are used for Level 3 functions. The capacities and capabilities are also often used as input to Level 4 scheduling, even if the production lines and work cells are not scheduled by the Level 4 functions.

5.3.8 Process cell and unit

Process cells and units are the lowest level of equipment typically scheduled by the Level 4 and Level 3 functions for batch manufacturing processes. Units are usually only identified at Level 3 and 4 if there is flexibility in the routing of the product within a process cell. The definitions for process cells and units are contained in IEC 61512-1.

The major processing capability or family of products produced often identifies the process cell.

NOTE For example, process cell identifiers from various industries are Mixing Line #5, West Side Glue Line, and Detergent Line 13.

Process cells and units have well-defined manufacturing capabilities and batch capacities, and these are used for Level 3 functions. The capacities and capabilities may also be used as input data for Level 4 scheduling, even if the process cells or units are not scheduled by the Level 4 functions.

5.3.9 Storage zone and storage unit

Storage zones and storage units are the lowest level of material movement equipment typically scheduled by the Level 4 and Level 3 functions for discrete, batch, and continuous manufacturing processes. A storage zone is a type of work center and a storage unit is a type of work unit that is organized as elements within an area. These are the lower-level elements of an equipment hierarchy used in material storage and movement activities.

A storage zone typically has the capability needed for the receipt, storage, retrieval, movement and shipment of materials. This may include the movement of materials from one work center to another work center within or between enterprises.

NOTE Material is also temporarily stored in process cells, production units, and production lines. This material is typically considered WIP and is usually distinct from inventory managed materials.