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Enterprise-control system integration –

Part 1:
Models and terminology

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ENTERPRISE-CONTROL SYSTEM INTEGRATION –

Part 1: Models and terminology

FOREWORD

1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, the IEC publishes International Standards. Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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3) The documents produced have the form of recommendations for international use and are published in the form of standards, technical specifications, technical reports or guides and they are accepted by the National Committees in that sense.
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International Standard IEC 62264-1 has been developed by subcommittee 65A: System aspects, of IEC technical committee 65: Industrial-process measurement and control, and by ISO technical committee 184/SC5: Architecture, communication and integration frameworks.

This standard is based upon ANSI/ISA-95.00.01-2000, Enterprise-Control System Integration, Part 1: Models and Terminology. It is used with permission of the copyright holder, the Instrumentation, Systems and Automation Society (ISA)*. ISA encourages the use and application of its industry standards on a global basis.

This standard was submitted to the National Committees for voting under the Fast Track Procedure as the following documents:

FDIS	Report on voting
65A/369/FDIS	65A/373/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table. In ISO, the standard has been approved by 10 P members out of 10 having cast a vote.

* For information on ISA standards, contact ISA at: ISA – The Instrumentation, Systems and Automation Society, PO Box 12277, Research Triangle Park, NC 27709, USA, Tel. 1+919.549.8411, URL: standards.isa.org.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

IEC 62264 consists of the following parts under the general title *Enterprise-control system integration:*

– Part 1: Models and terminology
– Part 2: Object models and attributes
– Part 3: Models of manufacturing operations

The committee has decided that the contents of this publication will remain unchanged until 2006. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

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

INTRODUCTION

IEC 62264 is a multi-part standard that defines the interfaces between enterprise activities and control activities. This standard provides standard models and terminology for describing the interfaces between the business systems of an entreprise and its manufacturing-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 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) reduce the costs of automating manufacturing processes;

e) optimize supply chains; and

f) reduce life-cycle engineering efforts.

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 standard discusses the interface content between manufacturing-control functions and other enterprise functions, based upon the Purdue Reference Model for CIM (hierarchical form) as published by ISA. This standard presents a partial model or reference model as defined in ISO 15704.

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

The intent of Clause 4 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 control system domain. Clause 4 does not contain the formal definitions of the models and terminology but describes the context to understand the other clauses.

The intent of Clause 5 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 control and the activities that occur at the business logistics level. It also gives an equipment hierarchy model of equipment associated with manufacturing control.

The intent of Clause 6 is to describe a general model of the functions within an enterprise which are concerned with the integration of business and control. It presents, 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 terminology for functions involved in information exchange.

The intent of Clause 7 is to state in detail the objects that make up the information streams defined in Clause 6. The purpose is to establish a common terminology for the elements of information exchanged.

Annex A defines the relationship of this standard with other related standardization work in the manufacturing area.

The intent of Annex B is to present the business reasons for the information exchange between business and control functions. The purpose is to establish a common terminology for the reason for information exchange.

Annex C discusses the rationale for multiple models.

Annex D contains selected elements from the Purdue Reference Model that may be used to place the functions described in Clauses 5 and 6 in context with the entire model.

Annex E is informative. It correlates the Purdue Reference Model to the MESA International Model.

This standard is intended for those who are

– involved in designing, building, or operating manufacturing facilities;
– responsible for specifying interfaces between manufacturing and process control systems and other systems of the business enterprise; or
– involved in designing, creating, marketing, and integrating automation products used to interface manufacturing operations and business systems.

Annex F is a discussion of systems, resources, capability, capacity, and time as used in this standard.

ENTERPRISE-CONTROL SYSTEM INTEGRATION –

Part 1: Models and terminology

1 Scope

This standard describes the interface content between manufacturing control 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 goal is to 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 organization of physical assets of an enterprise involved in manufacturing;

c) a listing of the functions associated with the interface between control functions and enterprise functions; and

d) 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 19501-1, *Information technology – Unified Modeling Language (UML) – Part 1: Specification* [1]

ISO 10303-1:1994, *Industrial automation systems and integration – Product data representation and exchange – Part 1: Overview and fundamental principles*

ISO 15531-1, *Industrial automation systems and integration – Industrial manufacturing management data – Part 1: General overview* [2]

ISO 15704:2000, *Industrial automation systems – Requirements for enterprise-reference architectures and methodologies*

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[1] To be published.

[2] To be published.

3 Terms and definitions

For the purposes of this document, the following definitions apply.

3.1
area
physical, geographical or logical grouping determined by the site

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

3.2
available capacity
portion of the production capacity that can be attained but is not committed to current or future production

3.3
bill of lading
BOL
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

3.4
bill of material
BOM
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

3.5
bill of resources
listing of all resources and when in the production process they are needed 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.

3.6
capability
ability to perform actions, including attributes on qualifications and measures of the ability as capacity

NOTE See Annex F for additional background on this concept.

3.7
capacity
measure of the ability to take action, a subset of a capability

NOTE See Annex F for additional background on this concept.

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

3.8
certificate of analysis
COA
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.

3.9
committed capacity
portion of the production capacity that is currently in use or is scheduled for use

3.10
consumables
resources that are not normally included in bills of material or are not individually accounted for in specific production requests

3.11
control domain
in this standard, control domain is synonymous with the manufacturing operations and control domain

3.12
enterprise
one or more organizations sharing a definite mission, goals and objectives to offer an output such as a product or service

3.13
equipment class
means to describe a grouping of equipment with similar characteristics for purposes of scheduling and planning

3.14
finished goods
final materials on which all processing and production is completed

3.15
finished good waivers
approvals for deviation from normal product specifications

3.16
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

3.17
manufacturing operations and control domain
MO&C
domain that includes all the activities in Level 3 and information flows to and from levels 0, 1, and 2 across the boundary to Level 4

3.18
material class
means to describe a grouping of materials with similar characteristics for purposes of scheduling and planning

3.19
material lot
uniquely identifiable amount of a material

NOTE It describes the actual total quantity or amount of material available, its current state, and its specific property values.

3.20
material definition
definition of the properties and characteristics for a substance

3.21
material sublot
uniquely identifiable subset of a material lot, containing quantity and location

NOTE This may be a single item.

3.22
personnel class
means to describe a grouping of persons with similar characteristics for purposes of scheduling and planning

3.23
process segment
view of a collection of resources 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

NOTE This may include material, energy, personnel, or equipment.

3.24
production capacity
ability of resources to perform production in the enterprise. The production capacity includes the capacity of those resources and represents

a) the collection of personnel, equipment, material, and process segment capabilities;

b) the total of the current committed, available, and unattainable capacity of the production facility;

c) the highest sustainable output rate that could be achieved for a given product mix, raw materials, worker effort, plant, and equipment

3.25
production control
collection of functions that manages all production within a site or area

3.26
production line
series of pieces of equipment dedicated to the manufacture of a specific number of products or families

3.27
production rules
information used to instruct a manufacturing operation how to produce a product

3.28
production unit
set of production equipment that converts, separates, or reacts one or more feedstocks to produce intermediate or final products

3.29
product segments
shared information between a bill of resources and a production rule for a specific product

NOTE A logical grouping of personnel resources, equipment resources, and material specifications required to carry out the production step.

3.30
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)

3.31
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.

3.32
work cell
dissimilar machines grouped together to produce a family of parts having similar manufacturing requirements

4 Enterprise-control system integration overview

4.1 Introduction

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

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

a) Hierarchy models that describe the 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.

NOTE 1 Selected elements of the *Purdue Reference Model for CIM* are included in Annex D.

NOTE 2 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 Clause 7.

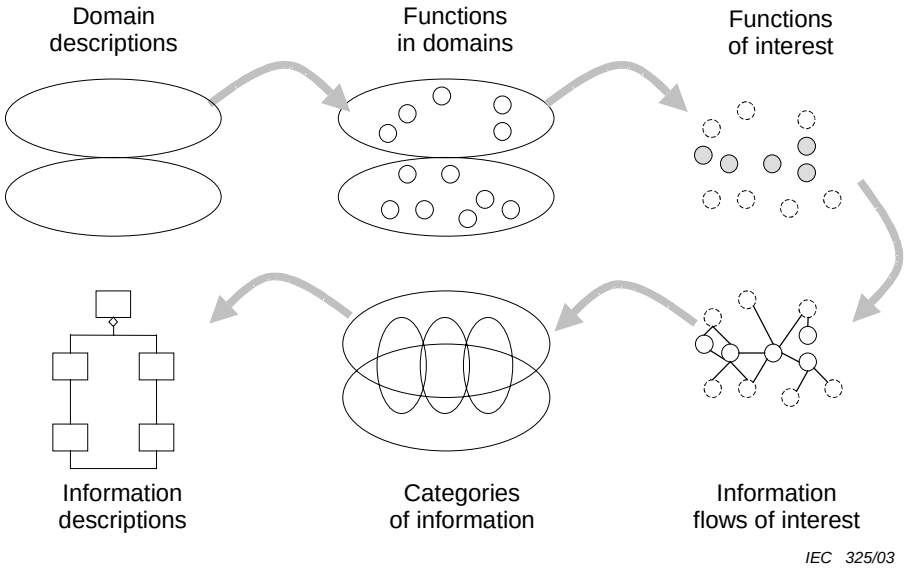

Figure 1 – Outline of models in the standard