

DIN EN 62264-4

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Siehe Anwendungsbeginn

**Integration von Unternehmensführungs- und Leitsystemen –
Teil 4: Attribute des Objektmodells zur Integration des
Betriebsmanagements
(IEC 62264-4:2015);
Englische Fassung EN 62264-4:2016**

Enterprise-control system integration –

Part 4: Object model attributes for manufacturing operations management integration
(IEC 62264-4:2015);

English version EN 62264-4:2016

Intégration des systèmes entreprise-contrôle –

Partie 4: Attributs des modèles d'objets pour l'intégration de la gestion des opérations de
fabrication

(IEC 62264-4:2015);

Version anglaise EN 62264-4:2016

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Anwendungsbeginn

Anwendungsbeginn für die von CENELEC am 2016-01-20 angenommene Europäische Norm als DIN-Norm ist 2016-10-01.

Nationales Vorwort

Vorausgegangener Norm-Entwurf: E DIN EN 62264-4:2014-06.

Für dieses Dokument ist das nationale Arbeitsgremium K 931 „Systemaspekte“ der DKE Deutsche Kommission Elektrotechnik Elektronik Informationstechnik in DIN und VDE (www.dke.de) zuständig.

Die enthaltene IEC-Publikation wurde vom SC 65E „Devices and integration in enterprise systems“ erarbeitet.

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Da sich die Benutzer der vorliegenden Norm der englischen Sprache als Fachsprache bedienen, wird die Englische Fassung der EN 62264-4 veröffentlicht. Zu deren Abschnitt 1, der den Anwendungsbereich festlegt, und Abschnitt 3, der die Begriffe festlegt, wurde eine Übersetzung angefertigt und als Nationaler Anhang NA der vorliegenden Norm hinzugefügt. Für einige der verwendeten Begriffe existieren keine gebräuchlichen deutschen Benennungen, da sich die deutschen Anwender in der Regel ebenfalls der englischen Benennungen bedienen. Diese Norm steht nicht in unmittelbarem Zusammenhang mit Rechtsvorschriften und ist nicht als Sicherheitsnorm anzusehen.

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Nationaler Anhang NA (informativ)

Einleitung^{N1)}

Dieser Teil der DIN EN 62264 legt die Schnittstelle zwischen Unternehmensaktivitäten und Steuerungsmaßnahmen fest und ist gemeinsam mit DIN EN 62264-3 zu verwenden.

Der Anwendungsbereich dieses Teils der DIN EN 62264 ist auf das Festlegen von Einzelheiten zum Informationsgehalt von Schnittstellen im Rahmen des Betriebsmanagements begrenzt. Der Anwendungsbereich ist auf das Festlegen der Objektmodelle und Attribute für die in DIN EN 62264-3 festgelegten Informationen begrenzt. Ziel ist es, Aufwand, Kosten und Fehler im Zusammenhang mit der Realisierung dieser Schnittstellen zu verringern.

Die Norm kann dazu verwendet werden, den mit der Realisierung neuer Produktangebote verbundenen Aufwand zu verringern. Das Ziel besteht darin, Unternehmens- und Steuerungssysteme zu erhalten, die zusammenarbeiten und integrationsfähig sind.

Dieser Teil der DIN EN 62264 legt des Weiteren Objektmodelle und Attribute fest, die am Datenaustausch zwischen den Aktivitäten des Betriebsmanagements, wie in DIN EN 62264-3 festgelegt, beteiligt sind. Die in DIN EN 62264-3 und in diesem Teil von DIN EN 62264 festgelegten Modelle und die Terminologie

- a) legen über den gesamten Lebenszyklus der Systeme Wert auf gute Integrationspraktiken des Betriebsmanagements,
- b) können verwendet werden, um die vorhandene Integrationsfähigkeit der Betriebsmanagementsysteme zu verbessern, und
- c) können ungeachtet des Automatisierungsgrades angewandt werden.

Insbesondere DIN EN 62264-3 und dieser Teil von DIN EN 62264 stellen eine Normungsterminologie sowie eine einheitliche Zusammenstellung von Konzepten und Modellen für integrierende Betriebsmanagementsysteme bereit, was die Kommunikation zwischen allen beteiligten Parteien verbessern wird. Die entstehenden Vorteile werden:

- d) für den Anwender den Zeitraum bis zum Erreichen der Vollproduktionsstufe für neue Produkte verringern,
- e) Anbieter in die Lage versetzen, entsprechende Instrumente zur Realisierung der Integration von Betriebsmanagementsystemen bereitzustellen,
- f) Anwender dazu befähigen, ihre Anforderungen besser zu bestimmen,
- g) die Kosten für die Automatisierung von Herstellungsprozessen senken,
- h) Versorgungsketten optimieren und
- i) den planungstechnischen Aufwand für den Lebenszyklus senken.

DIN EN 62264-3 und dieser Teil von DIN EN 62264 können verwendet werden, um den mit der Realisierung neuer Produktangebote verbundenen Aufwand zu verringern. Das Ziel besteht darin, Betriebsmanagementsysteme zu erlangen, die zusammenarbeiten und integrationsfähig sind.

Es ist nicht die Absicht der Normen,

- 1) zu behaupten, dass es nur eine Art gibt, die Integration von Betriebsmanagementsystemen umzusetzen,
- 2) Anwender zu zwingen, ihre gegenwärtige Art des Umgangs mit Integration aufzugeben, oder
- 3) eine Entwicklung im Bereich der Integration von Betriebsmanagementsystemen zu begrenzen.

^{N1)} Nationale Fußnote: Die Nummerierung aus IEC 62264-4 wurde beibehalten.

1 Anwendungsbereich

Dieser Teil legt Objektmodelle und Attribute fest, die zwischen den in IEC 62264-3 festgelegten Aktivitäten des Betriebsmanagements der Ebene 3 ausgetauscht werden.

3 Begriffe, Abkürzungen und Konventionen

3.1 Begriffe

Für die Anwendung dieses Dokuments gelten die Begriffe nach IEC 62264-1 und die folgenden Begriffe.

3.1.1

Aufzeichnung zur Chargenproduktion

(en: batch production record)

BPR

Untermenge der Ausführungs- und Geschäftsinformationen, deren Aufbewahrung auf Geschäftsanforderungen basieren, die in den Festlegungen zu Aufzeichnungen zur Chargenproduktion angegeben sind

Anmerkung 1 zum Begriff: Diese Anmerkung gilt ausschließlich für die Französische Sprache.

[QUELLE: IEC 61512-4:2009, 3.2]

3.1.2

Auftragsliste

(en: job list)

Sammlung von Fertigungsaufträgen für einen oder mehrere Betriebe und/oder von Ressourcen für einen bestimmten zeitlichen Rahmen

3.1.3

Arbeitsauftrag

(en: job order)

Einheit einer disponierten Arbeit, deren Ausführung geplant ist

3.1.4

Auftragsrückmeldung

(en: job response)

Angaben bezüglich des Ergebnisses der Ausführung eines Arbeitsauftrags

3.1.5

Rückmeldungsliste zu Arbeitsaufträgen

(en: job response list)

Sammlung von Auftragsrückmeldungen für einen oder mehrere Betriebe und/oder Ressourcen für einen bestimmten zeitlichen Rahmen

3.1.6

Ressourcenanordnungsnetzwerk

(en: resource relationship network)

eine oder mehrere Festlegungen für eine Verbindung zwischen zwei oder mehreren Ressourcen

3.1.7

Arbeitsbenachrichtigung

(en: work alert)

Benachrichtigung zu einem Ereignis der Ebene 3, die keine Bestätigung erfordert

3.1.8

Arbeitszeitkalender

(en: work calendar)

Sammlung von Arbeitszeitkalendereinträgen

3.1.9**Arbeitszeitkalendereintrag**

(en: work calendar entry)

Information zu einem bestimmten Zeitraum

3.1.10**Arbeitsfähigkeit**

(en: work capability)

Sammlung von Informationen zu den Ressourcen für die Arbeit in ausgewählten vergangenen und zukünftigen Zeiträumen

3.1.11**Arbeitsdefinition**

(en: work definition)

Sammlung von Informationen zu Ressourcen und Festlegungen zum Arbeitsablauf im Zusammenhang mit Arbeitsaufträgen

3.1.12**Arbeitsanweisung**

(en: work directive)

von einer Arbeitsbezugsvorlage abgeleitete Art der Arbeitsdefinition, die verwendet wird, um einen speziellen Arbeitsauftrag auszuführen

3.1.13**Arbeits-KPI**

(en: work KPI)

zentrale Leistungskennzahl, die sich auf Aktivitäten der Ebene 3 bezieht

3.1.14**Arbeitsmustervorlage**

(en: work master)

Art der Arbeitsdefinition, die eine Vorlage für die Arbeit darstellt, die im Rahmen eines Arbeitsauftrags auszuführen ist

3.1.15**Arbeitsleistung**

(en: work performance)

Sammlung von Arbeitsrückmeldungen

Anmerkung 1 zum Begriff: Diese Anmerkung gilt ausschließlich für die Französische Sprache.

3.1.16**Tauglichkeit zur Arbeitsmustervorlage**

(en: work master capability)

Sammlung von Informationen zu Ressourcen bezüglich ausgewählter vergangener und zukünftiger Zeiträume für eine spezielle Arbeitsmustervorlage

3.1.17**Arbeitsdatensatz**

(en: work record)

Untermenge der Ausführungs- und Geschäftsinformationen, deren Aufbewahrung auf Geschäftsanforderungen basieren

3.1.18**Arbeitsanfrage**

(en: work request)

Sammlung von Arbeitsaufträgen

3.1.19

Arbeitsrückmeldung

(en: work response)

Sammlung von Auftragsrückmeldungen

3.1.20

Arbeitszeitplan

(en: work schedule)

detaillierter Zeitplan der Aktivitäten des Betriebsmanagements in Form einer Sammlung von Arbeitsanfragen

3.1.21

Festlegung zum Arbeitsablauf

(en: workflow specification)

Informationen, die Arbeit als Tätigkeitsmuster darstellen, das zur Koordination der Ausführung von Verfahrensabläufen eingesetzt wird

BEISPIEL Eine reproduzierbare Abfolge von Verfahrensabläufen, ermöglicht durch eine Organisation der Ressourcen mit festgelegten Aufgaben, die dem Massen-, Energie- oder Informationsdurchsatz entsprechen.

3.2 Symbole und Abkürzungen

BPMN	Geschäftsprozessmodell und -notation	(en: Business Process Model and Notation)
BPR	Aufzeichnung zur Chargenproduktion	(en: Batch production record)
ERP	Warenwirtschaft	(en: Enterprise resource planning)
ID	Kennung	(en: Identifier)
KPI	zentrale Leistungskennzahl	(en: Key performance indicator)
MES	System der Fertigungsausführung	(en: Manufacturing execution system)
MOM	Betriebsmanagement	(en: Manufacturing operations management)
SOP	Standardbetriebsabläufe	(en: Standard operating procedures)
UML	vereinheitlichte Modellierungssprache	(en: Unified Modeling Language)
UTC	koordinierte Weltzeit	(en: Coordinated Universal Time)

3.3 Konventionen

Der kursive Schriftschnitt wurde über die in der ISO/IEC Richtlinie 2 definierte Verwendung hinausgehend angewandt, um die spezifische Bedeutung der Terminologie der Normenreihe IEC 62264 hervorzuheben. Kursiv wird in den folgenden Fällen angewandt:

- Benennung von Einheiten, die in Austauschdaten verwendet wurden.

English Version

Enterprise-control system integration - Part 4: Object model
attributes for manufacturing operations management integration
(IEC 62264-4:2015)

Intégration des systèmes entreprise-contrôle - Partie 4:
Attributs des modèles d'objets pour l'intégration de la
gestion des opérations de fabrication
(IEC 62264-4:2015)

Integration von Unternehmensführungs- und Leitsystemen -
Teil 4: Attribute des Objektmodells für die Integration des
Betriebsmanagements
(IEC 62264-4:2015)

This European Standard was approved by CENELEC on 2016-01-20. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

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European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

European foreword

The text of document 65E/479/FDIS, future edition 1 of IEC 62264-4, prepared by SC 65E "Devices and integration in enterprise systems", of IEC/TC 65 "Industrial-process measurement, control and automation" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 62264-4:2016.

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- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2016-10-20
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2019-01-20

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Endorsement notice

The text of the International Standard IEC 62264-4:2015 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 61512 (series)	NOTE	Harmonized as EN 61512 (series).
IEC 62541 (series)	NOTE	Harmonized as EN 62541 (series).

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INTRODUCTION

This part of IEC 62264 defines the interfaces between enterprise activities and control activities and is to be used in conjunction with IEC 62264-3.

The scope of this part of IEC 62264 is limited to defining the details of the information content of interfaces within manufacturing operations management. The scope is limited to the definition of object models and attributes for the information defined in IEC 62264-3. The goal is to reduce the effort, cost, and errors associated with implementing these interfaces.

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

This part of IEC 62264 further defines the object models and attributes involved in data exchange between activities of manufacturing operations management defined in 62264-3. The models and terminology defined in IEC 62264-3 and this part of IEC 6226

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

Specifically, IEC 62264-3 and this part of IEC 62264 provide a standard terminology and a consistent set of concepts and models for integrating manufacturing operations management systems that will improve communications between all parties involved. Benefits produced will

- d) reduce the user's time to reach full production levels for new products;
- e) enable vendors to supply appropriate tools for implementing integration of manufacturing operations management systems;
- f) enable users to better identify their needs;
- g) reduce the cost of automating manufacturing processes;
- h) optimize supply chains; and
- i) reduce life-cycle engineering efforts.

IEC 62264-3 and this part of IEC 62264 may be used to reduce the effort associated with implementing new product offerings. The goal is to have manufacturing operations management systems that interoperate and easily integrate.

It is not the intent of the standards to

- 1) suggest that there is only one way of implementing integration of manufacturing operations management systems;
- 2) force users to abandon their current way of handling integration; or
- 3) restrict development in the area of integration of manufacturing operations management systems.

ENTERPRISE-CONTROL SYSTEM INTEGRATION –

Part 4: Object model attributes for manufacturing operations management integration

1 Scope

This part defines object models and attributes exchanged between Level 3 manufacturing operations management activities defined in IEC 62264-3.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 62264-1:2013, *Enterprise-control system integration – Part 1: Models and terminology*

IEC 62264-2:2013, *Enterprise-control system integration – Part 2: Object and attributes for enterprise-control system integration*

IEC 62264-3, *Enterprise-control system integration – Part 3: Activity models of manufacturing operations management*

IEC 61512-1, *Batch control – Part 1: Models and terminology*

IEC 61512-4:2009, *Batch control – Part 4: Batch production records*

IEC 62682, *Management of alarm systems for the process industries*

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

ISO/IEC 19505-1, *Information technology – Object Management Group Unified Modeling Language (OMG UML) – Part 1: Infrastructure*

ISO/IEC 19505-2, *Information technology – Object Management Group Unified Modeling Language (OMG UML) – Part 2: Superstructure*

ISO 8601, *Data elements and interchange formats – Information interchange – Representation of dates and times*

3 Terms, definitions, abbreviations and conventions

3.1 Terms and definitions

For the purposes of this document the terms and definitions given in IEC 62264-1 as well as the following apply.

3.1.1

batch production record

BPR

subset of the execution and business information that is retained based upon business requirements identified by the batch production record specification

Note 1 to entry: This note applies to the French language only.

[SOURCE: IEC 61512-4:2009, 3.2]

3.1.2

job list

collection of job orders for one or more work centers and/or resources for a specific time frame

3.1.3

job order

unit of scheduled work that is dispatched for execution

3.1.4

job response

information on the result of execution of a job order

3.1.5

job response list

collection of job responses for one or more work centers and/or resources for a specific time frame

3.1.6

resource relationship network

one or more expressions of a relationship between two or more resources

3.1.7

work alert

notification of a Level 3 event that does not require acknowledgement

3.1.8

work calendar

collection of work calendar entries

3.1.9

work calendar entry

information about a specific time period

3.1.10

work capability

collection of information about the resources for work for selected future and past times

3.1.11

work definition

collection of information about resources and workflow specification associated with job orders

3.1.12

work directive

type of work definition derived from a work master and used to perform a specific job order

3.1.13

work KPI

key performance indicator related to Level 3 activities

3.1.14

work master

type of work definition that is a template for work to be performed for a job order

3.1.15

work performance

collection of work responses

Note 1 to entry: This note applies to the French language only.

3.1.16

work master capability

collection of information about the resources for selected future and past times for a specific work master

3.1.17

work record

subset of the execution and business information that is retained based upon business requirements

3.1.18

work request

collection of job orders

3.1.19

work response

collection of job responses

3.1.20

work schedule

detailed schedule of MOM activities as a collection of work requests

3.1.21

workflow specification

information representing work as a pattern of activities used to orchestrate the execution of procedures

EXAMPLE A repeatable sequence of procedures, enabled by an organization of resources with defined roles corresponding to flows of mass, energy or information.

3.2 Symbols and abbreviations

BPMN	Business Process Model and Notation
BPR	Batch production record
ERP	Enterprise resource planning
ID	Identifier
KPI	Key performance indicator
MES	Manufacturing execution system
MOM	Manufacturing operations management
SOP	Standard operating procedures
UML	Unified Modeling Language
UTC	Coordinated Universal Time

3.3 Conventions

Italics are used, beyond the use defined in ISO/IEC Directives Part2, to emphasize the 62264 specific meaning of terminology. They are used for the following cases:

- Names of objects used in exchanged data

4 Information exchange between manufacturing operations

4.1 Activity information exchange network

A set of models are used to represent the information exchanged between activities defined in IEC 62264-3. This is illustrated in Figure 1 with each information model represented as black rounded rectangles. This part of IEC 62264 defines models of information which can be exchanged between Level 3 activities (represented as ellipses in the figure) within an operational category or across operational categories. IEC 62264-2 defines models of information that may be exchanged between Level 4 activities and Level 3 activities and are represented as yellow rounded rectangles. Other information (represented as hashed elements) shown in Figure 1 is defined in other standards, such as IEC 61512 and IEC 62541.

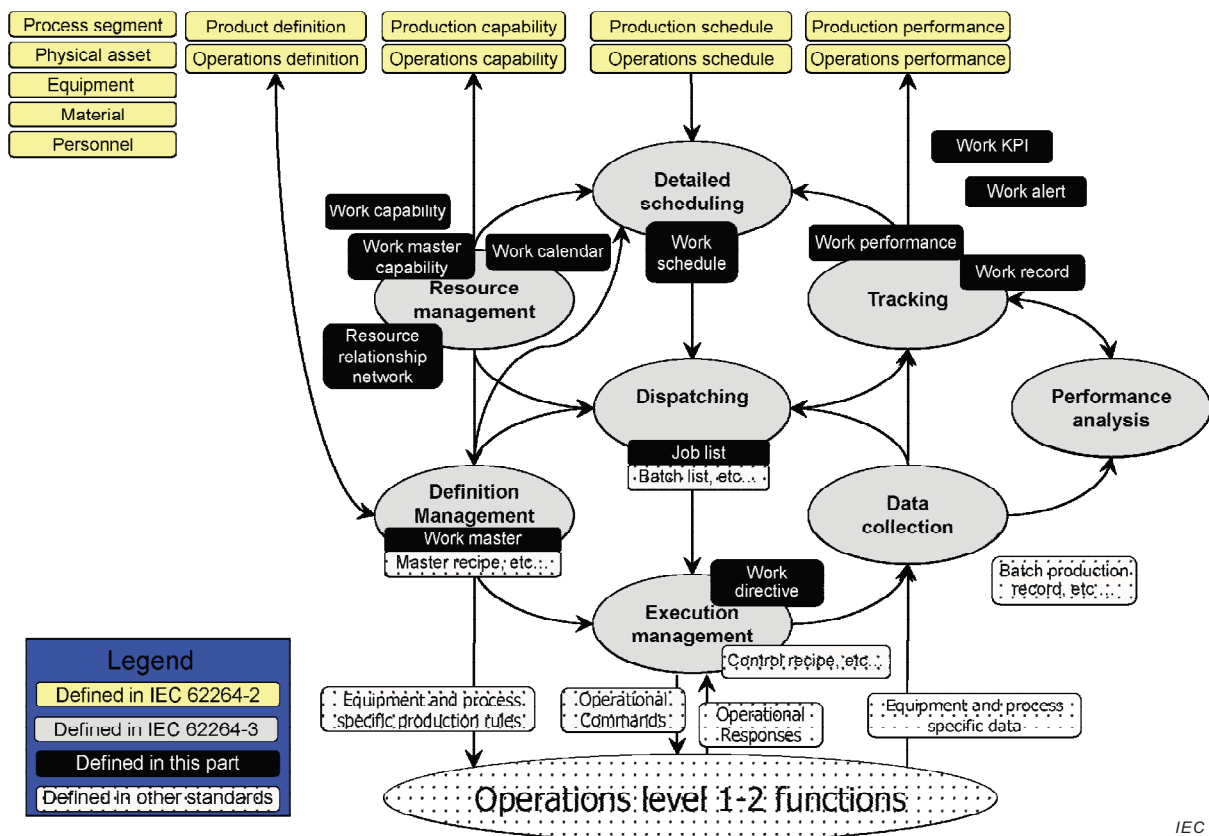


Figure 1 – Information exchange models for manufacturing operations management

NOTE IEC 61512 defines object models that relate to the lower elements of the Level 3 activities and defines the information used to create and manage master recipes, control recipes, batch lists, and batch production records. Equivalent structures, or IEC 61512 structures, could be used for other types of production. This standard does not redefine these objects.

4.2 Information exchange models

4.2.1 Overview

The information exchange models define structures that can be used to define, manage, and execute work within Level 3. The models are similar in structure to those defined in IEC 62264-2 but are defined for information exchange between Level 3 activities.

4.2.2 Process segments and work masters

IEC 62264-2 models define the view of manufacturing as seen by Level 4 business systems and based on a view of the manufacturing processes defined in *process segments*. The models of this part of IEC 62264 define the view of manufacturing as seen by Level 3 operations and are based on a view of the manufacturing processes defined in *work masters*.

Work masters define the resources and steps for *job orders* that are scheduled, displayed, executed, and tracked by Level 3 activities.

NOTE IEC 62264-2 models are used to exchange information from the process segment (business) view for Level 4 planning. Models such as *operations definition* and *operations schedule* support the allocation of resources and scheduling activities to the plant. Models in this part of IEC 62264 are used to exchange information for Level 3 execution. Models such as *work master* reference the operations definition exchanged with Level 4, but they have the details needed for actual execution of Level 3 activities. See Annex B for additional discussion of IEC 62264-2, this part of IEC 62264, and IEC 61512 model relationships.

4.2.3 Common resource definitions

The object models in this part of IEC 62264 use the personnel, equipment, physical asset, and material information defined in IEC 62264-2. When used with Level 3 work objects, the personnel, equipment, physical asset, and material information may include information required for Level 3 activities in addition to the information required to be shared with Level 4 activities.

EXAMPLE 1 The personnel information required for Level 3 activities can include detailed experience and qualification levels that are not shared with a Level 4 personnel or training management system.

EXAMPLE 2 The material information maintained for Level 3 activities can include subplot information which is not shared with Level 4 material management systems.

EXAMPLE 3 Delivery, usage and emission of energy units can be handled as material information.

4.2.4 Work models

The following object models are defined in this part of IEC 62264.

- 1) Resource relationship network – *Resource relationship networks* are created by tasks in resource management and definition management activities.
- 2) Work definition
 - a) Work master – *Work masters* are created by an engineering activity defined in IEC 62264-1 and to be managed by a task in definition management activities.
 - b) Work directive – *Work directives* are created by a task in execution management activities.
- 3) Work schedule – *Work schedules* are created by a task in detailed scheduling activities.
- 4) Job list – *Job lists* are created by a task in dispatching activities.

NOTE 1 In this part of IEC 62264, the term job is sometimes used instead of job order when referring to an entry in a job list.

- 5) Work performance – *Work performances* are created by a task in tracking activities.
- 6) Work capability – *Work capabilities* are created by a task in resource management activities.
- 7) Work master capability – *Work master capabilities* are created by a task in resource management activities.

8) Work KPI – *Work KPIs* may be created by a task in any of the activities.

NOTE 2 See ISO 22400 for a definition of the KPI object model, attributes, and standard KPIs.

9) Work alert – *Work alerts* may be created by any activity in the activity model.

10) Work calendar – *Work calendars* may be created by a task in resource management activities.

NOTE 3 *Work calendars* can also be created by a task in a Level 4 activity.

11) Work record – *Work records* are created by a task in tracking activities.

5 Object model representation

5.1 Minimum attribute sets

Clause 5 describes the methods used to define object models and attributes for information exchanged in between Level 3 activities. The attributes are part of the definition of object models for exchanged information.

A minimum set of industry-independent information are defined as attributes of the object models. However, values for all attributes may not be required depending on the actual usage of the models. If additional information, including industry- and application-specific information, is needed, it shall be represented as property objects. This solution increases the usability through the use of standard attributes, and allows flexibility and extensibility through the use of properties.

NOTE This was written to make the standard as widely applicable as practical.

5.2 Attribute extensibility

For particular applications, the objects defined in the object models will be extended through the addition of attributes to object class definitions. Accordingly this standard provides for attributes that are application or industry specific, to be modeled in terms of properties and represented in property classes in the model.

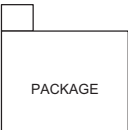
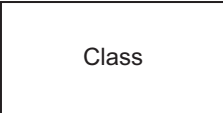
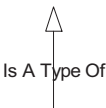
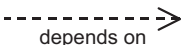
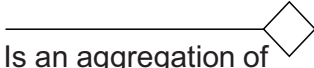
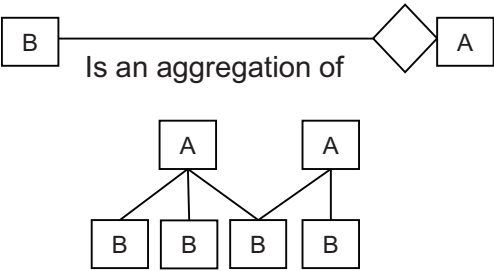
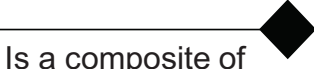
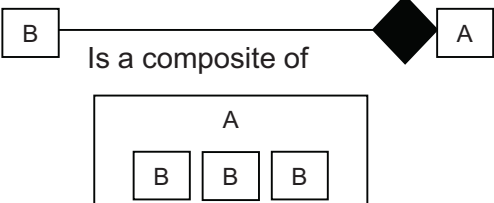
EXAMPLE The personnel class property may define application- or industry-specific attributes for personnel classes, and person property may contain values for the properties.

5.3 Object model structure

The object models are depicted using the Unified Modeling Language (UML) notational methodology, as defined in ISO/IEC 19501, ISO/IEC 19505-1 and ISO/IEC 19505-2.

Table 1 defines the UML notations used in the object diagrams.

Table 1 – UML notation used

Symbol	Definition
	Defines a package, a collection of object models, state models, use cases, and other UML models. Packages are general-purpose grouping mechanisms used to organize semantically related model elements. In this document a package is used to specify an external model, such as a production rule model, or a reference to another part of the model.
	Represents a UML class of objects, each with the same types of attributes. Each object is uniquely identifiable or enumerable. No operations or methods are listed for the classes.
	An association between elements of a class and elements of another or the same class. Each association is identified. May have the expected number or range of members of the subclass, when 'n' indicates an indeterminate number. For example, 0..n means that zero or more members of the subclass may exist.
	Generalization (arrow points to the super class) shows that an element of the class is a specialized type of the super class.
	Dependence is a weak association that shows that a modeling element depends on another modeling element. The item at the tail depends on the item at the head of the relationship.
	Aggregation shows that an element of the class is made up of elements of other classes. EXAMPLE 1 
	Composite shows a strong form of aggregation, which requires that a part instance be included in at most one composite at a time and that the composite object has sole responsibility for disposition of its parts. EXAMPLE 2 

5.4 Conventions used in table of attributes

5.4.1 Attribute table elements

A table is used to describe the attributes of each object in the object model. Each attribute table includes a listing of object attributes, as follows: the object identification, data types, and examples of the attributes and their values.

All attributes in the tables shall be considered optional, except where specified as required in the attribute description.

5.4.2 Object identification

Many objects in the information model require unique identifications (IDs). These IDs shall be unique within the scope of the exchanged information. This may require translations:

- from the internal ID of the source system to the interface content ID
- from the interface content ID to the internal ID of the target system

EXAMPLE A unit can be identified as “X6777” in the interface content, as resource “R100011” in the business system, and as “East Side Reactor” in the control system.

A unique identification set shall be agreed upon in an implementation in order to exchange information.

The object IDs are used only to identify objects within related exchanged information sets. The object ID attributes are not global object IDs or database index attributes.

Generally, objects that are elements of aggregations, and are not referenced elsewhere in the model, do not require unique IDs.

5.4.3 Data types of attributes

The attributes presented are abstract representations, without any specific data type specified.

EXAMPLE 1 An attribute can be represented as a string in one implementation and as a numeric value in another implementation.

EXAMPLE 2 A date/time value can be represented in ISO 8601 standard format in one implementation and in the Julian calendar format in another.

EXAMPLE 3 A relationship can be represented by two fields (type and key) in data base tables or by a specific tag in XML.

5.4.4 Value types

Value attributes are used in properties, parameters, and data to exchange actual values.

Value attributes are also used to exchange the allowed or expected values in properties and parameters. See IEC 62264-2:2013, 4.8, for a complete definition.

5.4.5 Presentation of examples

Example attribute values are included for each attribute. Examples are presented for each of the main operations categories defined in IEC 62264-3. See Table 2 below for how the example rows and columns are used.

Table 2 – Example table

Attribute name	Description	Production examples	Maintenance examples	Quality examples	Inventory examples
Name of first attribute	Description of first attribute	Production example	Maintenance example	Quality example	Inventory example
Name of second attribute	Description of second attribute	Production example	Maintenance example	Quality example	Inventory example
Name of third attribute	Description of third attribute	Production example	Maintenance example	Quality example	Inventory example

When an example value is a set of values, or a member of a set of values, the set of values is given within a set of braces, {}.

NOTE The examples are purely made up. They are provided to further describe attributes in the model. No attempt was made to make the examples complete or representative of any manufacturing enterprise.

5.4.6 References to resources

The models used to document a reference to a resource, in another package with additional optional specification using properties, are not fully illustrated in IEC 62264-2 object model figures. See IEC 62264-2:2013, 4.5.5, for a complete description of data relationships.

6 Resource relationship network model

6.1 Resource relationship network

Resource relationship networks shall be used to describe relationships between two or more resources in order to represent information that may be required for detailed scheduling activities, dispatching activities, execution activities, or other Level 3 activities.

Each *resource relationship network* is a collection of *resource network connections*, as shown in Figure 2.

Each *resource relationship connection* shall be represented as a directed connection between a *to resource reference* and a *from resource reference*.

NOTE 1 Relationships are represented as directed multi-graphs in graph theory. Each relationship represents an “edge” with the resource references represented as vertices.

NOTE 2 The properties of the resource relationship elements are used to represent constraints in the network, such as constraints in flow, direction, set or ordering.

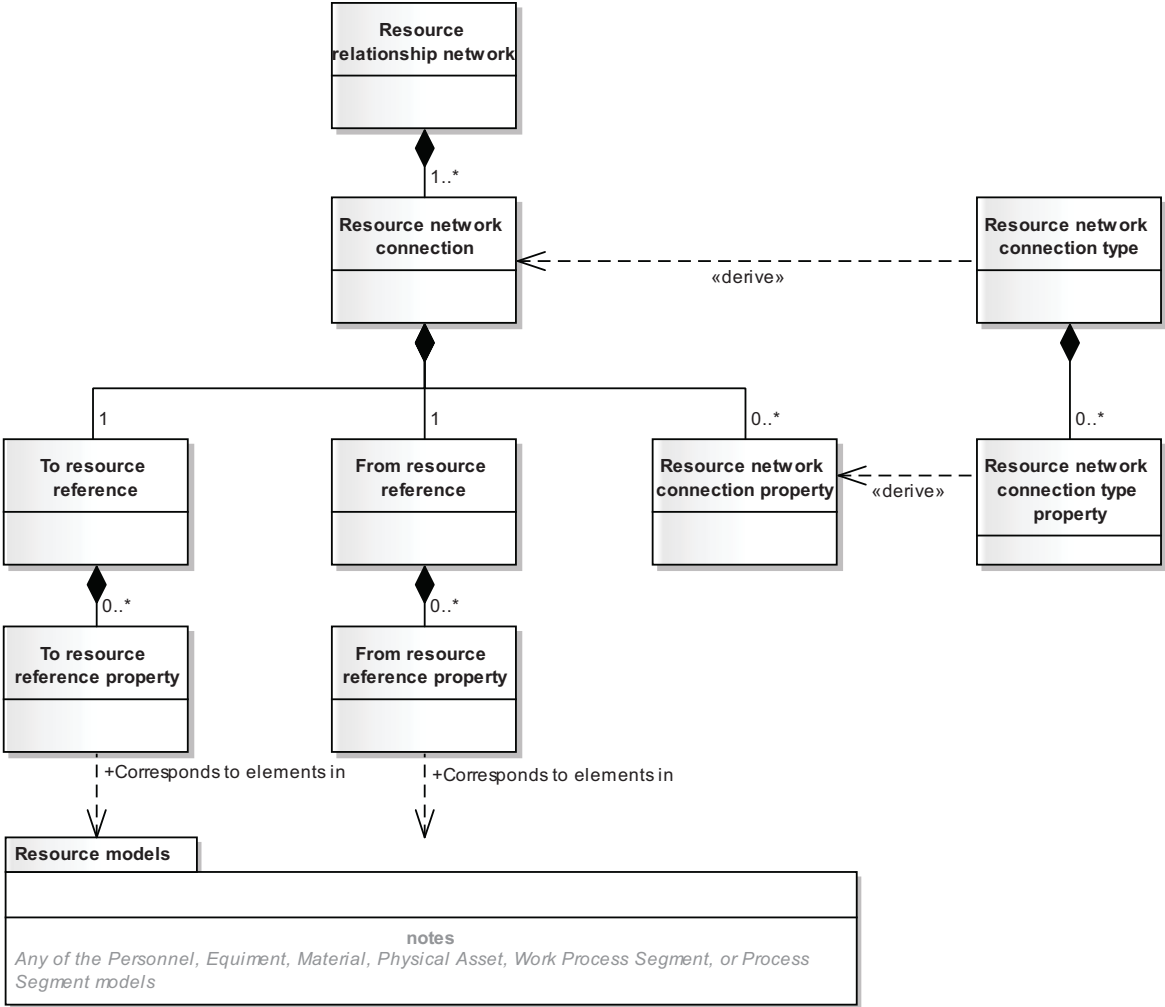
EXAMPLE 1 A “route” *resource network connection* between equipment can include properties that include the material transport time between the equipment and the material transfer rate between the equipment.

EXAMPLE 2 An “approved for use” *resource network connection* between equipment and material definitions can define which specific equipment has been approved for use with specific materials. A property of the *resource network connection* can be the date at which the approval for use is expired or revoked.

EXAMPLE 3 A “material substitution” *resource network connection* can define a primary material and the list of possible alternate materials.

Each *resource network connection* is defined by a *resource network connection type*. The *resource network connection type* may include *resource network connection type properties*, which define the allowable *resource network connection properties*.

NOTE 3 The *resource relationship network* model is conceptually similar to the MIMOSA CCOM network model. See Bibliography.



IEC

Figure 2 – Resource relationship network model

6.2 Resource relationship network attributes

A *resource relationship network* shall be a composition of one or more *resource network connections*.

Table 3 defines the attributes for *resource relationship network* objects.

Table 3 – Resource relationship network attributes

Attribute name	Description	Production examples	Maintenance examples	Quality examples	Inventory examples
ID	A unique identification of a <i>resource relationship network</i> .	BN5FP	B5EN	B5RS	BFFTR
Description	A description of the <i>resource relationship network</i> .	Building 5 flow path	Building 5 electrical network	Building 5 receive signoff	Building 5 fork truck route
Relationship type	Optional: Defines the type of the relationship. The defined types are: Physical – The elements of the relationship are physically connected or in the same area. Logical – The elements of the relationship are not necessarily physically connected or in the same area.	Physical	Physical	Logical	Logical
Relationship form	Optional: Defines the form of the relationships. The defined types are: Permanent – The relationship is not intended to be split or changed during operations processes. Transient – The relationship may be split or changed during operations processes.	Permanent	Permanent	Permanent	Transient

6.3 Resource network connection

The directed relationship between two resources in a resource relationship network shall be defined as a *resource network connection*.

A *resource network connection* shall be composed of the following:

- a *from resource reference* relationship defining one *resource reference* (as the starting point of a directed connection or the tail of an arrow that graphically represents the relationship);
- a *to resource reference* relationship defining one *resource reference* (as the ending point of a directed connection or the head of an arrow that graphically represents the relationship);
- zero or more *resource network connection properties*;
- an associated *resource network connection type*.

Table 4 defines the attributes for *resource network connection* objects

Table 4 – Resource network connection attributes

Attribute name	Description	Production examples	Maintenance examples	Quality examples	Inventory examples
ID	A unique identification of a <i>resource network connection</i> .	7685	6383290	Hyuwq9	TT28623
Description	A description of a <i>resource network connection</i> .	Piping	Wiring	Next signer	Next stop

6.4 Resource network connection property

A property of a *resource network connection* shall be defined as a *resource network connection property*.

Resource network connection properties are used to contain property values that are associated with the specific connection.

Table 5 defines the attributes of *resource network connection property* objects.

Table 5 – Resource network connection property attributes

Attribute name	Description	Production examples	Maintenance examples	Quality examples	Inventory examples
ID	A unique identification of a <i>resource network connection property</i> .	Pipe type	Gauge	N/A	Inside
Description	Additional information about the <i>resource network connection property</i> .	Type of piping	Wire type	N/A	Location
Value	The value, set of values, or range of the property.	53	20	N/A	TRUE
Value unit of measure	The unit of measure of the associated property value, if applicable.	Steel grade	AWG	N/A	Boolean

6.5 From resource reference

A “from” reference to a resource shall be defined as a *from resource reference*.

A *from resource reference* may be composed of zero or more *from resource reference properties*.

Table 6 defines the attributes for *from resource reference* objects.

Table 6 – From resource reference attributes

Attribute Name	Description	Production Examples	Maintenance Examples	Quality Examples	Inventory Examples
ID	A unique identification of a <i>from resource reference</i> .	12345	12346	A123	S7728
Resource ID	The ID of a resource.	B5Tank08	B5V480Box	Supervisor	Line3EndOfLine
Resource type	The type of the resource. The defined types are: Personnel class Person Equipment class Equipment Physical asset class Physical asset Material class Material definition Material lot Material subplot Work master Process segment Operation definition Operations segment	Equipment	Physical asset	Personnel class	Equipment

6.6 From resource reference property

A property of a *from resource reference* shall be defined as a *from resource reference property*.

NOTE A *from resource reference* with one or more *from resource reference properties* defines the subset of the *resource* that has the defined *resource property* values.

Table 7 defines the attributes for *from resource reference property* objects.

Table 7 – From resource reference property attributes

Attribute name	Description	Production examples	Maintenance examples	Quality examples	Inventory examples
ID	A unique identification of a <i>from resource reference property</i> .	A7872	CB101	HhJw78	Tye8
Property ID	The ID of a resource property.	Outlet flow rate	Circuit breaker	Shift	Storage Bay
Value	A value of a property that is used to identify the subset of the resources that are referenced.	200	40	First	42
Value unit of measure	The unit of measure of the associated property value, if applicable.	L/min	A	N/A	N/A