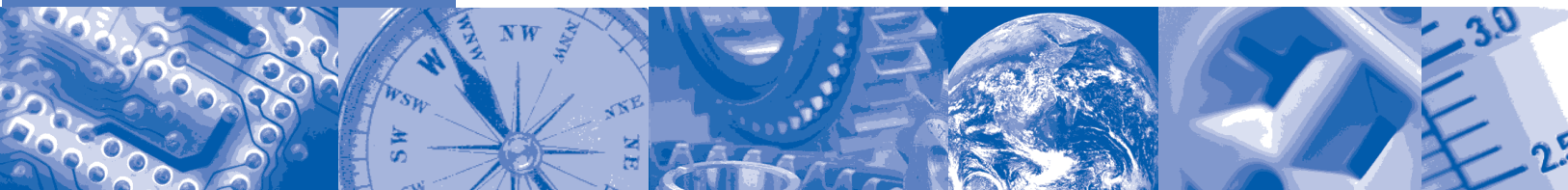


ANSI/ISA-95.00.02-2001



Enterprise-Control System Integration Part 2: Object Model Attributes



**ISA—The Instrumentation,
Systems, and
Automation Society**

Approved 17 October 2001



Documents
Document Sharing Hub

ANSI/ISA-95.00.02-2001

ANSI/ISA-95.00.02-2001
Enterprise-Control System Integration Part 2: Object Model Attributes

ISBN: 1-55617-773-9

Copyright © 2001 by ISA-The Instrumentation, Systems, and Automation Society. All rights reserved. Not for resale. Printed in the United States of America. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means (electronic, mechanical, photocopying, recording, or otherwise), without the prior written permission of the Publisher.

ISA
67 Alexander Drive
P. O. Box 12277
Research Triangle Park, North Carolina 27709
USA

Preface

This preface, as well as all footnotes and annexes, is included for information purposes and is not part of ANSI/ISA-95.00.02-2001.

The standards referenced within this document may contain provisions which, through reference in this text, constitute requirements of this document. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this document are encouraged to investigate the possibility of applying the most recent editions of the standards indicated within this document. Members of IEC and ISO maintain registers of currently valid International Standards. ANSI maintain registers of currently valid U.S. National Standards.

This document has been prepared as part of the service of ISA—The Instrumentation, Systems, and Automation Society, toward a goal of uniformity in the field of instrumentation. To be of real value, this document should not be static but should be subject to periodic review. Toward this end, the Society welcomes all comments and criticisms and asks that they be addressed to the Secretary, Standards and Practices Board; ISA; 67 Alexander Drive; P. O. Box 12277; Research Triangle Park, NC 27709; Telephone (919) 549-8411; Fax (919) 549-8288; E-mail: standards@isa.org.

The ISA Standards and Practices Department is aware of the growing need for attention to the metric system of units in general, and the International System of Units (SI) in particular, in the preparation of instrumentation standards. The Department is further aware of the benefits to USA users of ISA standards of incorporating suitable references to the SI (and the metric system) in their business and professional dealings with other countries. Toward this end, this Department will endeavor to introduce SI-acceptable metric units in all new and revised standards, recommended practices, and technical reports to the greatest extent possible. *Standard for Use of the International System of Units (SI): The Modern Metric System*, published by the American Society for Testing & Materials as IEEE/ASTM SI 10-97, and future revisions, will be the reference guide for definitions, symbols, abbreviations, and conversion factors.

It is the policy of ISA to encourage and welcome the participation of all concerned individuals and interests in the development of ISA standards, recommended practices, and technical reports. Participation in the ISA standards-making process by an individual in no way constitutes endorsement by the employer of that individual, of ISA, or of any of the standards, recommended practices, and technical reports that ISA develops.

CAUTION — ISA ADHERES TO THE POLICY OF THE AMERICAN NATIONAL STANDARDS INSTITUTE WITH REGARD TO PATENTS. IF ISA IS INFORMED OF AN EXISTING PATENT THAT IS REQUIRED FOR USE OF THE STANDARD, IT WILL REQUIRE THE OWNER OF THE PATENT TO EITHER GRANT A ROYALTY-FREE LICENSE FOR USE OF THE PATENT BY USERS COMPLYING WITH THE STANDARD OR A LICENSE ON REASONABLE TERMS AND CONDITIONS THAT ARE FREE FROM UNFAIR DISCRIMINATION.

EVEN IF ISA IS UNAWARE OF ANY PATENT COVERING THIS STANDARD, THE USER IS CAUTIONED THAT IMPLEMENTATION OF THE STANDARD MAY REQUIRE USE OF TECHNIQUES, PROCESSES, OR MATERIALS COVERED BY PATENT RIGHTS. ISA TAKES NO POSITION ON THE EXISTENCE OR VALIDITY OF ANY PATENT RIGHTS THAT MAY BE INVOLVED IN IMPLEMENTING THE STANDARD. ISA IS NOT RESPONSIBLE FOR IDENTIFYING ALL PATENTS THAT MAY REQUIRE A LICENSE BEFORE IMPLEMENTATION OF THE STANDARD OR FOR INVESTIGATING THE VALIDITY OR SCOPE OF ANY PATENTS BROUGHT TO ITS ATTENTION. THE USER SHOULD CAREFULLY INVESTIGATE RELEVANT PATENTS BEFORE USING THE STANDARD FOR THE USER'S INTENDED APPLICATION.

HOWEVER, ISA ASKS THAT ANYONE REVIEWING THIS STANDARD WHO IS AWARE OF ANY PATENTS THAT MAY IMPACT IMPLEMENTATION OF THE STANDARD NOTIFY THE ISA STANDARDS AND PRACTICES DEPARTMENT OF THE PATENT AND ITS OWNER.

ADDITIONALLY, THE USE OF THIS STANDARD MAY INVOLVE HAZARDOUS MATERIALS, OPERATIONS OR EQUIPMENT. THE STANDARD CANNOT ANTICIPATE ALL POSSIBLE APPLICATIONS OR ADDRESS ALL POSSIBLE SAFETY ISSUES ASSOCIATED WITH USE IN HAZARDOUS CONDITIONS. THE USER OF THIS STANDARD MUST EXERCISE SOUND PROFESSIONAL JUDGMENT CONCERNING ITS USE AND APPLICABILITY UNDER THE USER'S PARTICULAR CIRCUMSTANCES. THE USER MUST ALSO CONSIDER THE APPLICABILITY OF ANY GOVERNMENTAL REGULATORY LIMITATIONS AND ESTABLISHED SAFETY AND HEALTH PRACTICES BEFORE IMPLEMENTING THIS STANDARD.

The following individuals served as voting members of ISA-SP95:

NAME	COMPANY
K. Unger, Chairman	EnteGreat, Inc.
D. Brandl, Editor	Sequencia Corp.
D. Adler	Eli Lilly & Co.
W. Bosler	Texas Consultants, Inc.
B. Brown	E I du Pont de Nemours and Co.
Y. Carrier	KEOPS Technologies
K. Chambers	Intellution, Inc.
C. Clements	Honeywell IAC
C. Conklin	Dow Corning Corp.
L. Craig	Rohm and Haas Co.
R. Crossan	SAP America, Inc.
D. Emerson	Yokogawa Corp. of America
J. Jeffreys	Wonderware, Inc.
B. Korkmaz	Automation Vision, Inc.
K. Kovacs	Real Enterprise Solutions
D. Kravitt	SCT Corp.
C. Monchinski	Automated Control Concepts, Inc.
P. Moylan	Rockwell Software
S. Patnaik	Fisher-Rosemount Systems, Inc.
A. Poorman	ABB Automation, Inc.
L. Poulson	Novo Nordisk Engineering, A/S
G. Rathwell	Enterprise Consultants
S. Singh	ABB Industri AS
L. Steinocher	Fluor Daniel, Inc.
W. Strauss	Moore Products Co.
J. Vieille	Consultant
B. Ward	Consultant
T. Williams	Purdue University
W. Wray	Bayer Corp.

The following individuals also served on ISA-SP95:

NAME	COMPANY
G. Addison	Equistar Chemicals LP
B. Allgaier	ABB Industrial Systems, Inc.
S. Angioletti	Soft Brasil Sistemas de Gestao

R. Babecki
 W. Bajek
 K. Baker
 H. Bales
 J. Barry
 B. Boston
 T. Boucher
 R. Brokamp
 J. Brown
 R. Bullotta
 R. Burke
 J. Burnell
 R. Chappel
 D. Chappell
 L. Charpentier
 P. Cherry
 J. Clarke
 S. Cloughley
 P. Coddington
 E. Cosman
 P. Couling
 H. Crenshaw
 R. De Theije
 E. dela Hostria
 J. deSpautz
 A. Diaz
 D. Dziadiw
 L. Falkenau
 J. Fisher
 T. Fisher
 R. Flaherty
 D. Fleming
 C. Foster
 Y. Fujita
 G. Funk
 J. Gallagher
 M. Gallagher
 G. Garfein
 D. Gaw
 A. Goldberger
 D. Gussin
 A. Habib
 W. Hakanson
 J. Ham
 K. Harris
 D. Harrold
 W. Hawkins
 N. Haxthausen
 J. Hedrick
 S. Herb
 B. Hinds
 T. Hurst
 E. Icyan
 D. Imming

Foxboro Co.
 UOP
 Eli Lilly & Co.
 TRW
 Queue Systems, Inc.
 Hewlett-Packard Co.
 Rutgers University
 Jacobs Engineering
 Fisher-Rosemount Systems, Inc.
 Lightammer Software Corp.
 Price Waterhouse LLC
 Hewlett-Packard Canada
 Advanced Integration Group
 Procter & Gamble Co.
 GSE Systems, Inc.
 Cherry Services, Inc.
 ATCOR
 Base Ten Systems, Inc.
 Abbott Laboratories
 Dow Chemical Co.
 Consilium, Inc.
 Champion Intl.
 Consultant
 Rockwell Automation
 Real Enterprise Solutions
 All-Control Systems, Inc.
 Propack Data Corp.
 E I du Pont de Nemours
 Dow Corning, Inc.
 The Lubrizol Corp.
 IBM
 Rockwell Automation
 E I du Pont de Nemours and Co.
 Toyo Engineering Corp.
 GLF Technology
 Nestle UK, Ltd.
 Lubrizol Corp.
 Bay Area Instrument & Electric
 Coactive Aesthetics, Inc.
 Consultant
 Milltronics, Ltd.
 Walsh Automation
 MESA International
 Landacorp
 Honeywell POMS Corp.
 Control Engineering Magazine
 HLQ Ltd.
 Novo Nordisk Engineering A/S
 Automation & Control Tech, Inc.
 Siemens Moore Process Automation
 Weyerhaeuser Co.
 Hurst Technologies Corp.
 ACES, Inc.
 Fisher-Rosemount Systems, Inc.

C. Jaeger
J. Jakhura
B. Jensen
C. Johnsson
J. Kall
Z. Kamal
P. Kennedy
G. Kilgore
R. Kolz
A. Kowalczyk
E. Lambert
S. Laurents
L. Lavender
B. Lewis
P. Loeb
B. Long
W. Lorenz
R. Mackiewicz
E. Marks
B. Martin
R. Martin
M. Mcbreen
J. McCarville
E. McCutcheon
R. Mcdevitt
T. McFarlane
B. Medina
R. Mergen
M. Muroski
T. Murphy
L. Natiello
J. Orsulak
A. Pampel
R. Parapar
J. Parshall
J. Peltola
S. Pendegrass
M. Pichler
V. Pillai
E. Potts
Z. Rahman
J. Ramming
R. Raynes
A. Reddy
D. Rehbein
R. Rehbein
J. Reynolds
W. Richards
D. Riley
J. Ritter
S. Ryan
L. Sagadraca
H. Sakamoto
R. Salisbury

Eli Lilly & Co.
Syncrude Canada, Ltd.
Yokogawa Corp. of America
Siemens Orsi Automation
Interwave Technology, Inc.
ABB Automation, Inc.
California Environmental Controls
Voest-Alpine Industries, Inc.
OSI Software
Honeywell, Inc.
Real Enterprise Solutions
Fluor Daniel Co.
PIC, Inc.
Omron Electronics
Dickson
Realtime Information Systems
Eli Lilly & Co.
SISCO, Inc.
Square D Co./Schneider Auto
Crestone International
AMR Research
Price Waterhouse, Inc.
3M Co.
UOP LLC
MIKON Systems, Inc.
Metso Automation, Inc.
KPMG
The Lubrizol Corp.
ABB Industrial Systems, Inc.
PID Inc.
Merck
Raytheon Co.
A F Pampel Consulting
Genentech, Inc.
Eli Lilly & Co.
Siemens
Lyondell-Equistar
VECO Engineering
Pharmacia Corp.
Professional Services International, Inc.
Rohm & Haas, Co.
Eaton Corp.
Raynes Design & Engineering
Honeywell, Inc.
Microsoft Corp.
Wastewater Services-Metro PMC
Unilever HPC NA
Orsi Hilco Technologies, Inc.
Wonderware, Inc.
Shell
Rockwell Software, Inc.
McWhorter Technologies
Yokogawa Electric Corp.
ABB Industrial Systems, Inc.



J. Salkin
 Y. Sano
 R. Sardell
 R. Sattelmaier
 K. Sauermann
 J. Schaefer
 G. Shilberg
 M. Schmidt
 B. Schneitler
 K. Schwarz
 R. Seemann
 G. Sellner
 T. Shephard
 J. Siekierda
 E. Skabowski
 G. Spearpoint
 M. Spencer
 J. Stout
 B. Swanton
 S. Tavoulareas
 E. Todd
 G. Turanchik
 B. Tway
 N. Tying
 A. Vakamudi
 J. Vardy
 A. Vath
 A. Perez
 A. Vitale
 E. Vodopost
 P. Vreeswijk
 A. Weichert
 P. Weinberger
 R. Welk
 O. Wieser
 C. Williams
 G. Winchester
 R. Winslow
 D. Wisnosky
 K. Yuen

Ortho-McNeil Pharmaceuticals
 Y.M.P. International Corp.
 Foxboro Co.
 Union Carbide Corp.
 Werum GmbH
 ACS/Tava Technology
 Bayer Corp.
 Raytheon Engineers & Constructors
 GE Plastics
 Schwarz Consulting Co.
 Fisher-Rosemount Systems, Inc.
 Consultant
 Effective Solutions, Inc.
 Interwave Technology, Inc.
 Tendent Consulting
 Nestle South Africa Pty Ltd
 QIC Systems, Inc.
 Nexus Engineering, Inc.
 Advanced Mfg. Research
 EnTec
 Anheuser-Busch Co. Inc.
 Smart Signal
 Coors Brewing Co.
 TVC Inc.
 Bechtel Corp.
 Foxboro Co.
 Carpenter Specialty
 Initec SA
 Automation Mktg Strategies
 Consultant
 Arthur Andersen
 Automated Control Concepts, Inc.
 Casne Engineering, Inc.
 Hurst Consulting Co.
 SAP AG
 Eastman Kodak Co.
 National Electrical Mfrs Assn
 Sterling Electronics
 Wizdom Systems, Inc.
 Rockwell Software, Inc.

This standard was approved for publication by the ISA Standards and Practices Board on 23 September 2001.

NAME

COMPANY

M. Zielinski
 D. Bishop
 M. Cohen
 M. Coppler
 B. Dumortier
 W. Holland
 E. Icyan

Emerson Process Management
 Consultant
 Consultant
 Ametek, Inc.
 Schneider Electric
 Southern Company
 Advanced Control & Engineering Solutions

Copyright © 2001 ISA. All rights reserved.

This document may not be copied or provided to other persons in any form.



Documents
 Document Sharing Hub

A. Iverson
R. Jones
V. Maggioli
T. McAviney
A. McCauley, Jr.
G. McFarland
D. Rapley
R. Reimer
J. Rennie
H. Sasajima
I. Verhappen
R. Webb
W. Weidman
J. Weiss
M. Widmeyer
R. Wiegler
C. Williams
G. Wood

Ivy Optiks
Dow Chemical Co.
Feltronics Corp.
Merrick & Co.
Chagrin Valley Controls, Inc.
Westinghouse Process Control Inc.
Rapley Consulting Inc.
Rockwell Automation
Factory Mutual Research Corp.
Yamatake Corp.
Syncrude Canada Ltd.
Power Engineers
Parsons Energy & Chemicals Group
EPRI
EG&G Defense Materials
Power Engineers
Eastman Kodak Co.
Graeme Wood Consulting



Contents

Foreword	11
Introduction	13
1 Scope	15
2 Normative references	15
3 Definitions	15
4 Object model attributes	15
4.1 Introduction	15
4.2 Explanation of tables	16
4.3 Production capability model	19
4.4 Process segment capability model	27
4.5 Personnel model	33
4.6 Equipment model	37
4.7 Material model	43
4.8 Process segment model	48
4.9 Product definition information model	54
4.10 Production schedule model	60
4.11 Production performance model	69
5 Completeness, compliance and conformance	77
5.1 Completeness	77
5.2 Compliance	77
5.3 Conformance	77
Annex A (informative) — Examples	81
Annex B (informative) – Expected use	89
Annex C (informative) – Logical information flows	101

This page intentionally left blank.

Foreword

This standard is Part 2 of a multi-part set of standards that defines the interfaces between enterprise activities and control activities. It follows ANSI/ISA-95.00.01-2000, Enterprise-Control System Integration Part 1: Models and Terminology.

The scope of this Part 2 standard is limited to defining the details of the interface content between manufacturing control functions and other enterprise functions. 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.

The scope of this Part 2 standard is limited to the definition of the Part 1 object model attributes.

This Part 2 standard is structured to follow IEC guidelines. Therefore, the first three clauses present the *scope* of the standard, *normative references*, and *definitions*, in that order.

Clause 4 is normative. The intent is to describe the attributes associated with the objects defined in Part 1.

Clause 5 is normative. It defines completeness, conformance and compliance criteria associated with the objects defined in Part 1 and the attributes defined in Part 2.

Annex A is informative. It provides examples to illustrate how the models and attributes may be used.

Annex B is informative. It illustrates how the models could be used in different circumstances.

Annex C is informative. It discusses how the standard relates to logical information flows.

This page intentionally left blank.

Introduction

This Part 2 standard further defines the object models described in ANSI/ISA-95.00.01-2000, Enterprise-Control System Integration Part 1: Models and Terminology (hereafter referred to as Part 1) by adding attribute definitions and examples. The models and terminology defined in Part 1 and Part 2

- 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 capability of manufacturing control systems with enterprise systems; and
- c) can be applied regardless of the degree of automation.

Specifically, the Part 1 and Part 2 standards provide 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. Benefits produced will

- a) reduce the user's time 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 cost of automating manufacturing processes;
- e) optimize supply chains; and
- f) reduce life-cycle engineering efforts.

The Part 1 and Part 2 standards 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.

It is not the intent of the standards to

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

This page intentionally left blank.

1 Scope

This Part 2 standard, in conjunction with ANSI/ISA-95.00.01-2000, Enterprise-Control System Integration Part 1: Models and Terminology, defines 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 Part 1 and Part 2. The goal is to reduce the risk, cost, and errors associated with implementing these interfaces.

The scope of Part 2 is limited to the definition of attributes for the Part 1 object models.

This Part 2 standard does not define attributes to represent the object relationships defined in Part 1.

2 Normative references

The following normative documents contain provisions that, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. Members of the IEC and ISO maintain registers of currently valid normative documents.

- a) ANSI/ISA-95.00.01-2000, Enterprise-Control System Integration Part 1: Models and Terminology
- b) IEC 61512-1:1997, Batch control – Part 1: Models and terminology
- c) ANSI/ISA-88.01-1995, Batch Control Part 1: Models and Terminology
- d) ENV 40003:1991, Computer Integrated Manufacturing (CIM); Systems Architecture; Framework for Enterprise Modeling
- e) ENV 12204:1996, Advanced Manufacturing Technology; Systems Architecture; Constructs for Enterprise Modeling
- f) ISO 14258:1998, Concepts and Rules for Enterprise Models
- g) ISO 15704:2000, Industrial Automation Systems--Requirements for Enterprise--Reference Architectures and Methodologies

3 Definitions

For the purposes of this standard, the following definition applies. Other terms used in this Part 2 standard are defined in Part 1.

3.1 process segment:

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

4 Object model attributes

4.1 Introduction

This clause defines the attributes associated with the objects defined in the Part 1 standard.

Tables 2 through 87 in clause 4 define the attributes for objects defined in the Part 1 standard, clause 7. The attributes are an extension to the object information model defined in the Part 1 standard and thus are part of the definition of terms. The attributes of this Part 2 standard and the object models of Part 1 define interfaces for enterprise-control system integration.

A minimum set of industry-independent information has been defined, in this Part 2 standard, as attributes. However, values for all attributes may not be required depending of the actual usage of the models. If additional information, including industry- and application-specific information, is needed, it shall be represented as properties. This solution increases the usability through the use of standard attributes, and allows flexibility and extensibility through the use of properties. This was done to make the standard as widely applicable as possible.

4.2 Explanation of tables

This subclause defines the meaning of the attribute tables. This includes a definition of the object identification, data types, and definition of the examples in the tables.

4.2.1 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 translation of the IDs of the exchanged information from a system's internal identification. For example, a unit may be identified as resource "R100011" in the scheduling system and "East Side Reactor" in the manufacturing system. A unique identification set shall be agreed to in order to exchange information.

The object IDs are defined 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.

4.2.2 Data types

The attributes defined are abstract representations, without any specific data type defined. A specific implementation will define how the information is represented. For example,

- a) an attribute may be represented as a string in one implementation and as a numeric value in another implementation;
- b) a date/time value may be represented in ISO standard format in one implementation and in Julian calendar format in another; or
- c) a relationship may be represented by two fields (type and key) in data base tables or by a specific tag in XML.

4.2.3 Definition of examples

Examples are included with each attribute definition. Where multiple examples are used, there are multiple rows in the right hand column. See Table 1 below for how the example rows and columns are used.

Table 1 — Table example

Attribute Name	Description	Examples
Name of first attribute	Description of first attribute	Example #1 for first attribute
		Example #2 for first attribute
		Example #3 for first attribute
Name of second attribute	Description of second attribute	Example #1 for second attribute
		Example #2 for second attribute
		Example #3 for second attribute
Name of third attribute	Description of third attribute	Example #1 for third attribute
		Example #2 for third attribute
		Example #3 for third attribute

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

The examples are purely fictional. 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.

4.2.4 Data relationships

The models used to document a reference to a resource, in another package, using the class or instance, with additional optional specification using properties, are not fully illustrated in the Part 1 object model figures. This relationship is not conformant to the Unified Modeling Language (UML) modeling methodology, but was done to keep the diagrams simpler. Figure 1 below illustrates how it is currently presented, on the left side, and how it could be more accurately modeled in UML on the right side. UML was used in this standard as a visualization method and was not meant to describe implementations. This applies to the following models:

- | | |
|-----------------------------------|-----------------------------------|
| — Personnel Capability | — Equipment Capability |
| — Material Capability | — Personnel Segment Capability |
| — Equipment Segment Capability | — Material Segment Capability |
| — Personnel Segment Specification | — Equipment Segment Specification |
| — Material Segment Specification | — Personnel Specification |
| — Equipment Specification | — Material Specification |
| — Personnel Requirement | — Equipment Requirement |
| — Material Produced Requirement | — Material Consumed Requirement |
| — Consumable Expected | — Personnel Actual |
| — Equipment Actual | — Material Produced Actual |
| — Material Consumed Actual | — Consumable Actual |

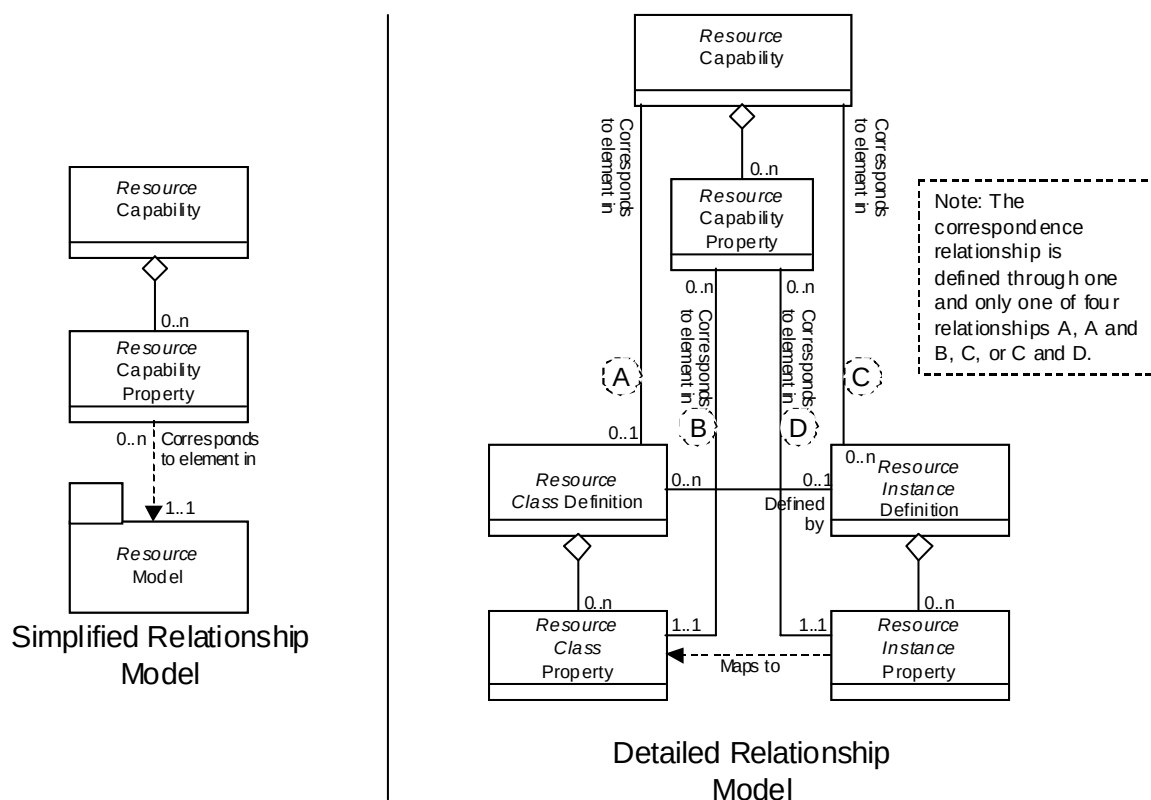


Figure 1 — Detailed relationship models

The correspondence relationship is defined through one and only one of four possible relationships: to the *resource class definition*; to the *resource class definition* and *resource class property*; to the *resource instance definition*; or to the *resource instance definition* and *resource instance property*.

In the model above the term *resource class* indicates: personnel class, equipment class, material class, and material definitions. The term *resource instance* indicates: person, equipment, material lot, and material subplot. The term *resource capability* indicates the use in the capability model, the process segment capability model, the process segment model, the product definition information model, the production schedule model, and the production performance model.

4.3 Production capability model

Figure 2 is a copy of Figure 15 in Part 1, with a clarification of the relationship to the personnel, equipment, and material models.

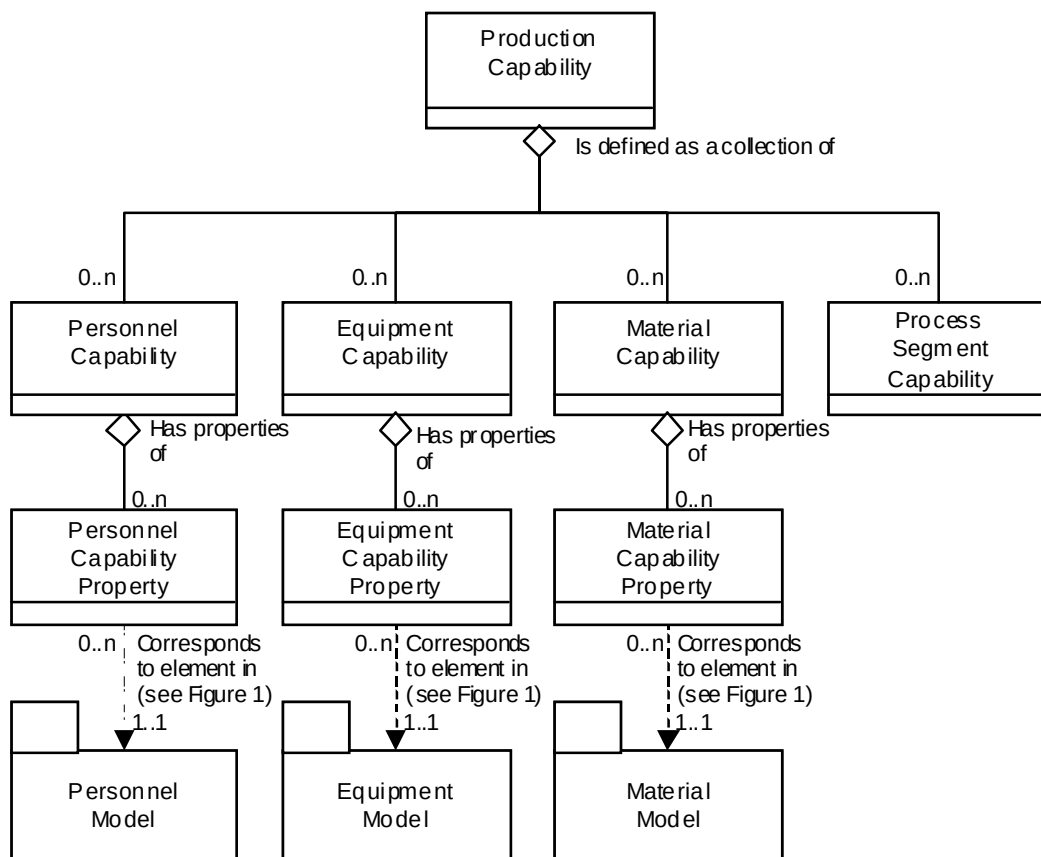


Figure 2 — Production capability model

4.3.1 Production capability

Table 2 defines the attributes for *production capability* objects.

Table 2 — Production capability attributes

Attribute Name	Description	Examples
ID	Defines a unique instance of a production capability for a specified element of the equipment hierarchy model [Part 1 Section 5.2] (<i>enterprise, site, area, process cell, production line, or production unit</i>).	1999/12/30-HPC52
		1999/12/30-HPC52.01
		1999/12/30-HPC52.01.02
Description	Contains additional information and descriptions of the <i>production capability</i> definition.	"One day's production capability for the Boston Widget Company."
		"One day's production capability for the South Shore Production Plant."
		"One day's production capability for the East Wing manufacturing line."
Capability Type	The capability type: Available, Unattainable, or Committed.	Available
		Unattainable
		Committed
Reason	Defines the reason for the capability type. For example, if committed, then committed for production or for maintenance; or if unavailable, then the reason for the unavailability.	Available for Production
		Due to Power Outage
		Available for Maintenance
Location	An identification of the associated element of the equipment hierarchy model. Zero or more as required to identify the specific scope of the production capability definition.	Boston Widget Company
		South Shore Production Plant
		East Wing Manufacturing Line #2
Element Type	A definition of the type of associated element of the equipment hierarchy model.	Enterprise
		Site
		Production line
Start Time	The starting date and time of the production capability.	1999-12-29 11:59
		1999-12-30 11:59
		1999-12-31 11:59
End Time	The ending date and time of the production capability.	1999-12-30 12:00
		1999-12-31 12:00
		2000-01-01 12:00
Published Date	The date and time on which the <i>production capability</i> was published or generated.	1999-11-03 13:55
		1999-11-03 13:55
		1999-11-03 13:55

4.3.2 Personnel capability

Table 3 defines the attributes for *personnel capability* objects.

Table 3 — Personnel capability attributes

Attribute Name	Description	Example
Personnel Class	Identifies the associated <i>personnel class</i> of the capability.	Widget Assembly Machine Operator
Person	Identifies the associated <i>person</i> of the capability.	SSN 999-55-1212
Description	Contains additional information and descriptions of the <i>personnel capability</i> definition.	"Widget machine operator availability over the 2000 New Year boundary"
Capability Type	The capability type: Available, Unattainable, or Committed.	Available
Reason	Defines the reason for the capability type.	Available for Production
Location	An identification of the associated element of the equipment hierarchy model. If omitted, then the capability is associated to the parent <i>production capability</i> location. Zero or more as required to identify the specific scope of the production capability definition.	South Shore Production Plant
Element Type	A definition of the type of associated element of the equipment hierarchy model.	Site
Start Time	The starting time associated with the <i>personnel capability</i> . If omitted, then the capability is associated to the parent <i>production capability</i> start time.	1999-12-30 11:59
End Time	The ending time associated with the <i>personnel capability</i> . If omitted, then the capability is associated to the parent <i>production capability</i> end time.	2000-01-01 12:00
Quantity	Specifies the quantity of the personnel capability defined, if applicable.	48
Quantity Unit of Measure	The unit of measure of the associated quantity, if applicable.	Hours

Where *persons* are members of multiple *personnel classes* then the *personnel capability* information defined by *personnel class* should be used carefully because of possible double counts, and personnel resources should be managed at the instance level.

4.3.3 Personnel capability property

Table 4 defines the attributes for *personnel capability property* objects.

Table 4 — Personnel capability property attributes

Attribute Name	Description	Examples
Property Name	An identification of a property of the associated <i>person property</i> or <i>personnel class property</i> .	Operator Level
		Packing Machine Certified
Description	Contains additional information and descriptions of the <i>personnel capability property</i> definition.	"Level of operator certification"
		"Level of packing machine operator certification"
Value	The value, set of values, or range of the property.	Apprentice
		Journeyman
Value Unit of Measure	The unit of measure of the associated property value, if applicable.	[not applicable]
		[not applicable]
Quantity	Specifies the quantity of the personnel capability defined, if applicable.	1
		16
Quantity Unit of Measure	The unit of measure of the associated quantity.	Days
		Hours

4.3.4 Equipment capability

Table 5 defines the attributes for *equipment capability* objects.

Table 5 — Equipment capability attributes

Attribute Name	Description	Examples
Equipment Class	Identifies the associated <i>equipment class</i> of the capability.	Widget Jig
		Widget Lathe
Equipment	Identifies the associated <i>equipment</i> of the capability.	Reactor 101
		Lathe machine 15
Description	Contains additional information and descriptions of the <i>equipment capability</i> definition.	"Widget Jig commitment over the 2000 New Year boundary"
		"Widget Lathe availability over the 2000 New Year boundary"
Capability Type	The capability type: Available, Unattainable, or Committed.	Committed
		Unattainable
Reason	Defines the reason for the capability type.	Available for Production
		Due to Y2K Noncompliance
Location	An identification of the associated element of the equipment hierarchy model. If omitted, then the capability is associated to the parent <i>production capability</i> location. Zero or more as required to identify the specific scope of the production capability definition.	South Shore Production Plant
Element Type	A definition of the type of associated element of the equipment hierarchy model.	Site
Start Time	The starting time associated with the <i>equipment capability</i> . If omitted, then the capability is associated to the parent <i>production capability</i> start time.	1999-12-30 11:59
		1999-12-30 11:59
End Time	The ending time associated with the <i>equipment capability</i> . If omitted, then the capability is associated to the parent <i>production capability</i> end time.	2000-01-01 12:00
		2000-01-01 12:00
Quantity	Specifies the quantity of the equipment capability defined, if applicable.	48
		2
Quantity Unit of Measure	The unit of measure of the associated quantity, if applicable.	Hours
		Days

Where *equipment* are members of multiple *equipment classes* then the *equipment capability* information defined by *equipment class* should be used carefully because of possible double counts, and equipment resources should be managed at the instance level.

4.3.5 Equipment capability property

Table 6 defines the attributes for *equipment capability property* objects.

Table 6 — Equipment capability property attributes

Attribute Name	Description	Examples
Property Name	An identification of a property of the associated <i>equipment property</i> or <i>equipment class property</i> .	Heating Capability
		Volume
Description	Contains additional information and descriptions of the <i>equipment capability property</i> definition.	"Measure of the heating capability"
		"Measure of the equipment volume"
Value	The value, set of values, or range of the property.	500
		10000
Value Unit of Measure	The unit of measure of the associated property value, if applicable.	BTU/Hour
		Liters
Quantity	Specifies the quantity of the equipment capability defined, if applicable.	2
		12
Quantity Unit of Measure	The unit of measure of the associated quantity.	Days
		Hours

4.3.6 Material capability

Table 7 defines the attributes for *material capability* objects.

Table 7 — Material capability attributes

Attribute Name	Description	Examples
Material Class	Identifies the associated <i>material class</i> of the capability.*	Polymer sheet stock 1001A
		Lubricant Oil
Material Definition	Identifies the associated <i>material definition</i> of the capability.*	Sheet stock 1443a
		Lube Oil 8999
Material Lot	Identifies the associated <i>material lot</i> of the capability.*	1443a5mm
		8999LU-5G
Material Sublot	Identifies the associated <i>material subplot</i> of the capability.*	1443a5mm-SL1
		8999LU-5G-SL15
Description	Contains additional information and descriptions of the <i>material capability</i> definition.	"Polymer sheet stock commitment"
		"Lubricant oil commitment over the 2000 New Year boundary"
Capability Type	The capability type: Available, Unattainable, or Committed.	Committed
		Committed
Reason	Defines the reason for the capability type.	Available for Production
		Available for Production
Location	An identification of the associated element of the equipment hierarchy model. If omitted, then the capability is associated to the parent <i>production capability</i> location. Zero or more as required to identify the specific scope of the production capability definition.	South Shore Production Plant
		Production Line 15
Element Type	A definition of the type of associated element of the equipment hierarchy model.	Site
		Production Line
Material Use	Defines the material use: Material Consumed, Material Produced, or Consumable	Material Consumed
		Material Consumed
Start Time	The starting time associated with the <i>material capability</i> . If omitted, then the capability is associated to the parent <i>production capability</i> start time.	1999-12-30 11:59
		1999-12-30 11:59
End Time	The ending time associated with the <i>material capability</i> . If omitted, then the capability is associated to the parent <i>production capability</i> end time.	2000-01-01 12:00
		2000-01-01 12:00
Quantity	Specifies the quantity of the material capability defined, if applicable.	2000
		155
Quantity Unit of Measure	The unit of measure of the material quantity, if applicable.	Sheets
		Liters

* Typically a *material class*, *material definition*, *material lot*, or *material subplot* is specified.

Where *materials* are members of multiple *material classes* then the *material capability* information defined by *material class* should be used carefully because of possible double counts, and material resources should be managed at the instance level.

4.3.7 Material capability property

Table 8 defines the attributes for *material capability property* objects.

Table 8 — Material capability property attributes

Attribute Name	Description	Examples
Property Name	An identification of a property of the associated <i>material property</i> or <i>equipment class property</i> .	Concentration
		pH
Description	Contains additional information and descriptions of the <i>material capability property</i> definition.	"Concentration of active ingredient"
		"pH of active ingredient"
Value	The value, set of values, or range of the property.	50
		6.3
Value Unit of Measure	The unit of measure of the associated property value, if applicable.	%
		pH
Quantity	Specifies the quantity of the material capability defined, if applicable.	55
		2567
Quantity Unit of Measure	The unit of measure of the associated quantity.	mL
		kiloliters

4.4 Process segment capability model

Figure 3 is a copy of Figure 16 in Part 1, with a clarification of the relationship to *process segments*, and the personnel, equipment, and material models.

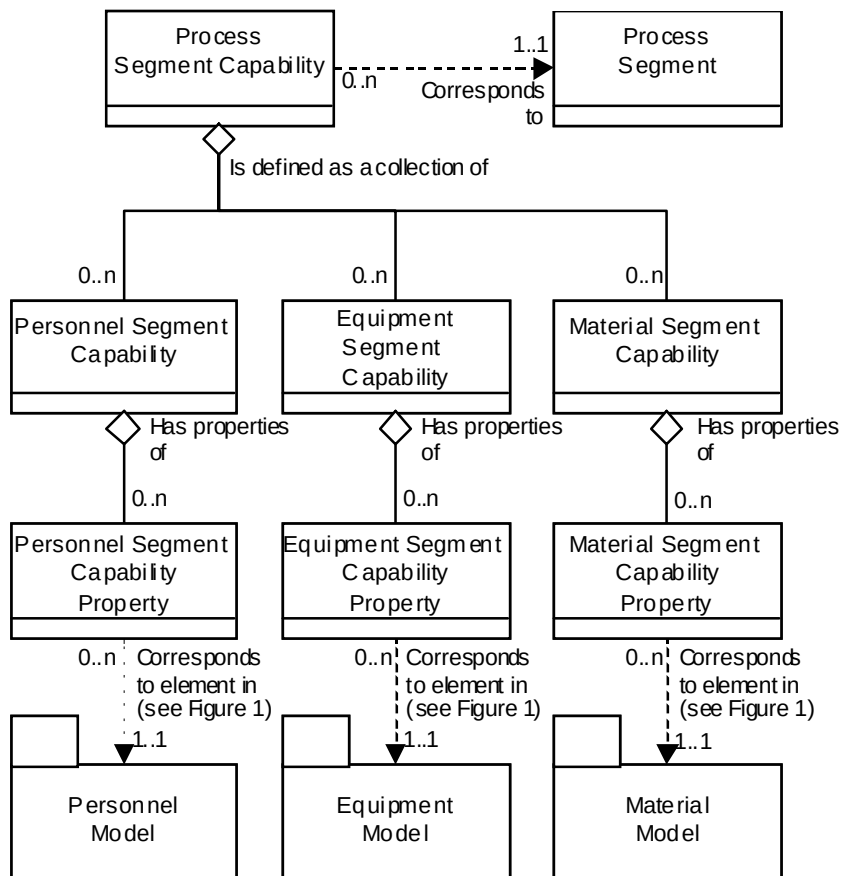


Figure 3 — Process segment capability

4.4.1 Process segment capability

Table 9 defines the attributes for *process segment capability* objects. *Process segment capability* has an equivalent structure to the personnel, equipment and material structure of *production capability*, except the *process segment capability* is defined for a specific *process segment*.

Table 9 — Process segment capability attributes

Attribute Name	Description	Example
ID	A unique identifier of the <i>process segment capability</i> within the scope of the parent <i>production capability</i> .	1000104
Description	Contains additional information and descriptions of the <i>process segment capability</i> definition.	"Defines the available capability for the Widget Assembly process segment"
Process Segment	Identifies the <i>process segment</i> .	Widget Assembly
Capability Type	The capability type: Available, Unattainable, or Committed.	Available
Reason	Defines the reason for the capability type.	Available for Production
Location	An identification of the associated element of the equipment hierarchy model. If omitted, then the capability is associated to the parent <i>production capability</i> location. Zero or more as required to identify the specific scope of the production capability definition.	Production Line #15
Element Type	A definition of the type of associated element of the equipment hierarchy model.	Production Line
Start Time	The starting time associated with the <i>process segment capability</i> . If omitted, then the capability is associated to the parent <i>production capability</i> start time.	1999-12-30 11:59
End Time	The ending time associated with the <i>process segment capability</i> . If omitted, then the capability is associated to the parent <i>production capability</i> end time.	2000-01-01 12:00

Process segment capabilities should be used carefully because of possible double counts of resources. For example, a resource may be shown as available in multiple *process segments*, but in actual fact may be available for use in only a single *process segment*.

4.4.2 Segment personnel capability

Table 10 defines the attributes for *segment personnel capability* attributes.

Table 10 — Segment personnel capability attributes

Attribute Name	Description	Example
Personnel Class	Identifies the set of associated <i>personnel classes</i> of the capability.	Assembly Operator
Person	Identifies the set of associated <i>persons</i> of the capability.	SSN 999-55-1212
Description	Contains additional information and descriptions of the <i>segment personnel capability</i> definition.	Available personnel for the Widget Assembly operation
Capability Type	The capability type: Available, Unattainable, or Committed.	Available
Reason	Defines the reason for the capability type.	Available for Production
Location	An identification of the associated element of the equipment hierarchy model. If omitted, then the capability is associated to the parent <i>production capability</i> location. Zero or more as required to identify the specific scope of the production capability definition.	Production Line #15
Element Type	A definition of the type of associated element of the equipment hierarchy model.	Production Line
Start Time	The starting time associated with the <i>segment personnel capability</i> . If omitted, then the capability is associated with the parent <i>process segment capability</i> start time.	1999-12-30 11:59
End Time	The ending time associated with the <i>segment personnel capability</i> . If omitted, then the capability is associated with the parent <i>process segment capability</i> end time.	2000-01-01 12:00
Quantity	Specifies the quantity of the personnel capability defined, if applicable.	48
Quantity Unit of Measure	The unit of measure of the associated quantity, if applicable.	Hours

Where *persons* are members of multiple *personnel classes*, then the *personnel capability* information defined by *personnel class* should be used carefully because of possible double counts, and personnel resources should be managed at the instance level.

4.4.3 Segment personnel capability property

Table 11 defines the attributes for *segment personnel capability property* objects.

Table 11 — Segment personnel capability property attributes

Attribute Name	Description	Example
Property Name	An identification of a property of the associated <i>person property</i> or <i>personnel class property</i> .	Assembly Operators
Description	Contains additional information and descriptions of the <i>segment personnel capability property</i> definition.	"Number of assembly operators available for the Widget assembly operation."
Value	The value, set of values, or range of the property.	Apprentice
Value Unit of Measure	The unit of measure of the associated property value, if applicable.	<not applicable>
Quantity	Specifies the quantity of the personnel capability defined, if applicable.	24
Quantity Unit of Measure	The unit of measure of the associated quantity, if applicable.	Hours

4.4.4 Segment equipment capability

Table 12 defines the attributes for *segment equipment capability* objects.

Table 12 — Segment equipment capability attributes

Attribute Name	Description	Example
Equipment Class	Identifies the associated <i>equipment class</i> of the capability.	Widget Assembly Jig
Equipment	Identifies the associated <i>equipment</i> of the capability.	JIG 101
Description	Contains additional information and descriptions of the <i>segment equipment capability</i> definition.	"Committed assembly jigs for the Widget assembly operation."
Capability Type	The capability type: Available, Unattainable, or Committed.	Committed
Reason	Defines the reason for the capability type.	Available for Production
Location	An identification of the associated element of the equipment hierarchy model. If omitted, then the capability is associated to the parent <i>production capability</i> location. Zero or more as required to identify the specific scope of the production capability definition.	Production Line #15
Element Type	A definition of the type of associated element of the equipment hierarchy model.	Production Line
Start Time	The starting time associated with the <i>segment equipment capability</i> . If omitted, then the capability is associated with the parent <i>process segment capability</i> start time.	1999-12-30 11:59
End Time	The ending time associated with the <i>segment equipment capability</i> . If omitted, then the capability is associated with the parent <i>process segment capability</i> end time.	2000-01-01 12:00
Quantity	Specifies the quantity of the equipment capability defined, if applicable.	1
Quantity Unit of Measure	The unit of measure of the associated quantity, if applicable.	Hours

Where *equipment* are members of multiple *equipment classes*, then the *equipment capability* information defined by *equipment class* should be used carefully because of possible double counts, and equipment resources should be managed at the instance level.

4.4.5 Segment equipment capability property

Table 13 defines the attributes for *segment equipment capability property* attributes.

Table 13 — Segment equipment capability property attributes

Attribute Name	Description	Example
Property Name	An identification of a property of the associated <i>equipment property</i> or <i>equipment class property</i> .	Jig Status
Description	Contains additional information and descriptions of the <i>segment equipment capability property</i> definition.	"Committed widgets per hour"
Value	The value, set of values, or range of the property.	Clean
Value Unit of Measure	The unit of measure of the associated property value, if applicable.	{Clean, Dirty}
Quantity	Specifies the quantity of the personnel capability defined, if applicable.	1
Quantity Unit of Measure	The unit of measure of the associated quantity.	Hours

4.4.6 Segment material capability

Table 14 defines the attributes for *segment material capability* objects.

Table 14 — Segment material capability attributes

Attribute Name	Description	Example
Material Class	Identifies the associated <i>material class</i> of the capability. *	Rivet-10002
Material Definition	Identifies the associated <i>material definition</i> of the capability. *	General Purpose 2mm rivet
Material Lot	Identifies the associated <i>material lot</i> of the capability. *	L66272
Material Sublot	Identifies the associated <i>material sublot</i> of the capability. *	L66272-SL4
Description	Contains additional information and descriptions of the <i>segment material capability</i> definition.	Rivets Available for the Widget Assembly Operation
Capability Type	The capability type: Available, Unattainable, or Committed.	Available
Reason	Defines the reason for the capability type.	Available for Production
Location	An identification of the associated element of the equipment hierarchy model. If omitted, then the capability is associated to the parent <i>production capability</i> location. Zero or more as required to identify the specific scope of the production capability definition.	Production Line #15
Element Type	A definition of the type of associated element of the equipment hierarchy model.	Production Line
Material Use	Defines the material use: Material Consumed, Material Produced, or Consumable.	Material Consumed
Start Time	The starting time associated with the <i>segment material capability</i> . If omitted, then the capability is associated with the parent <i>process segment capability</i> Start Time.	1999-12-30 11:59
End Time	The ending time associated with the <i>segment material capability</i> . If omitted, then the capability is associated with the parent <i>process segment capability</i> End Time.	2000-01-01 12:00
Quantity	Specifies the quantity of the material capability defined, if applicable.	3000
Quantity Unit of Measure	The unit of measure of the associated quantity, if applicable.	Pieces

* Typically either a *material class*, *material definition*, *material lot*, or *material sublot* is specified.

Where *materials* are members of multiple *material classes* then the *material capability* information defined by *material class* should be used carefully because of possible double counts, and material resources should be managed at the instance level.